The Online Resource Selection Instructional Design Script (ORSIDS)

by

Deborah Elizabeth "Sunny" Cohen

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Graduate School of Computer and Information Sciences
Nova Southeastern University

2005

We herby certify that this dissertation, submitted by Deborah Elizabeth "Sunny" Cohen, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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2005

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June 2005

The Online Resource Selection Instructional Design Script (ORSIDS) is a process "script" based on the ASSURE instructional design method, customized for use by consultative college-employed instructional designers in an online environment. This study investigated the development of this script and its efficacy in assisting college-employed instructional designers in guiding faculty with selecting online media and multimedia resources for their online courses.

The ORSIDS process script was developed iteratively through successive cycles of formative evaluation. In the Design Phase, members of an Expert Panel validated the candidate requirements proposed by the researcher. In the Development Phase, the product was developed and then refined utilizing field testing and a pilot study. In two rounds of pilot testing administered by two different Instructional Designer Subjects, one subject was more skillful in adhering to the script and communicating the basic instructional design processes. The Faculty Subject who participated in the more fully realized testing session demonstrated creative thought related to using technology in the curriculum on the level of the Bloom taxonomy "synthesis" level while the Faculty Member participating in the less well-realized session did not demonstrate similar creative thought.

The study established the value of teaching instructional design methodology to faculty members in the context of the development of their own online courses. Additionally, the study found that the group dynamics between the Instructional Designer and the Faculty Member in a dyad can have a substantial impact on process efficacy.

The value of the ORSIDS process and script was proven by the study. In the summative evaluation of the Final ORSIDS script conducted by the Expert Panel, the script was highly rated in achieving its goals of assisting in the more effective utilization of college-employed instructional designers, enhancing the pedagogical skills of online faculty, and increasing adoption of online resources. However, more testing is needed to know whether the final script submitted for summative evaluation is capable of resulting in process mastery on the part of administering instructional designers. Further cycles of iterative development will probably be necessary for maximally effective usability of this innovative and complex information product.

Acknowledgements

Many people assisted with the creation of this dissertation by providing various kinds of support. At the foundation of this project was the generosity of my aunt and uncle, Dr. Alvin Cohen and Dr. Tamara Cohen, who provided the encouragement to begin my doctoral studies, a home-away-from-home during the residencies that took place in this primarily online program, and moral and intellectual support throughout the process. I acknowledge with appreciation the supervision provided by my dissertation committee chairperson Dr. Timothy Ellis and the participation of the other committee members, Dr. Maxine Cohen and Dr. William Hafner. I am very grateful for the invaluable assistance with my dissertation provided by Dr. Steffen Saifer. The following individuals also contributed significantly: Dr. Hoyet Hemphill, Cathy Wood Wyrick, Dr. Stephen Gance, Dr. John Blanks, Dr. Doris Bolliger, Dr. Tom Hergert, Gail Block, and Diane McKinnon. The dissertation "support group" formed from members of my cohort at Nova Southeastern University offered critical moral and sometimes practical support; my fellow members were Shelly Bibeau, Dr. Beth Gosman, Dr. Ellen Scalese, Dr. Edit Szanto, Dr. Miri Schonfeld, and Dr. Pilar Toral. Others whose presence illuminated my world and fortified my spirit include Marilyn Powers, Diane Dreizen, Dr. Anthony Esau, my mother Dr. Dee Dropkin, my son Jonah, and my friends Armonica Gilford, Judy Mann, Pat Leach, Bill Beach, and Frank Tribble. I ask forgiveness from any others whose contributions I have neglected to mention.

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Chapter 1

Introduction

Problem Statement

The problems addressed by this dissertation study were three-fold. The overarching problem was the lack of online pedagogical skills possessed by online faculty (Ellis & Hafner, 2003). However, the study also addressed the problems with two solutions put in place to mend the first problem. One of these sub-problems resided with the less than effective deployment of the college-employed instructional designers increasingly being hired by colleges and universities to work with online faculty (Pan, Deets, Phillips, & Cornell, 2003). The other sub-problem consisted of the lack of educator adoption of online resources, particularly the learning objects and learning object repositories into which numerous organizations world wide have poured substantial financial resources (Gosper, Woo, Gibbs, Hand, Kerr, & Rich, 2004). This problem statement details these three problems in greater detail.

Teacher education must be based on an understanding of the expectations that teachers will have to meet (Goodlad, 1991). While e-learning is becoming prevalent in higher education, most college faculty lack the knowledge and skills necessary to design quality online courses (Davidson-Shivers, 2002). If college faculty are expected to design online courses, their lack of online-course-design skills must be remediated. Online course design requires knowledge in areas ranging from basic learning theory to the online pedagogy necessary to take advantage of the dynamic, flexible and technologically advanced e-learning environment (Miller & Miller, 1999). When instructors do not possess the necessary skills and expertise, the quality of the online courses that they develop suffers. Effective course design is the foundation for successful e-learning. Consistency in quality is imperative as uneven quality results in negative student experiences and mistrust on the part of the public in e-learning (Twigg, 2000a).

Recent literature recognizes that while classroom teaching provides a foundation for teaching online, the online environment necessitates a new model of instructor for whom additional skills need to be developed (Buchanan, 1999; Cohen, 2001; Collison, Elbaum, Haavkind & Tinker, 2000). One of the most critical skills is that of Web-based course design. Effective online courses cannot merely be duplicates of the instruction delivered in the classroom transferred to the Internet; online courses must be designed with knowledge of what works and what doesn't on the Web (Reiser, 2002). Poor faculty course design skills are an acknowledged barrier to the success of e-learning (Miller & Miller, 2000). For courses on the Web to be effective, their designers must be knowledgeable about learning theory, the students for whom the site is created and the objectives they should be able to reach. They must also know how to work with the capabilities of the software, including interactivity, graphic design, and streaming audio and video.

Designing online courses involves many more challenges than designing face-to-face courses. Online, there are numerous multimedia presentation modes and communications tools from which to choose (Rouet, 2001; Van Merrienboer & Martens, 2002). Jonassen (2001) defined multimedia presentation modes as the formats used to represent ideas in multimedia such as spoken words, written words, images and animation; he stated it is these attributes that affect learning. For a single online course, these choices must be made not once but multiple times. Choosing appropriate media can be a very difficult task for instructors who do not have the appropriate skills and experience.

For faculty to be successful at redesigning courses for Internet delivery, they must have the requisite skills (Twigg, 2000b). Faculty are not prepared to design online courses by their graduate education, which, except in graduate schools of education, focuses on a discipline rather than pedagogy. Modeling by previous instructors prepares faculty to teach face-to-face, but comparable modeling has not taken place to prepare faculty to teach online courses. Novice online course designers must be equipped with the knowledge of learning theory and online pedagogy - including the ability to make choices between various instructional delivery methods and media - necessary to prepare one to design online courses. Institutions that are recognized for the quality of their online courses attribute their success to providing faculty development opportunities in online course design to their faculty (Sorg & Darling, 2000).

Many institutions have dealt with faculty development in online course design by hiring instructional designers (Schwier, Campbell & Kenny, 2004). These instructional designers not only work with the faculty to produce the online courses but also assist faculty in acquiring technology integration skills enabling them to potentially take on more future responsibility for course development (Torrisi-Steele & Davis, 2000). Instructional designers have a much different role in higher education than they did in the past in the corporate arena. Instructional designers in higher education take on the role of change agents who are responsible for diffusing technological innovations to the faculty with whom they work. Schwier, Campbell and Kenny (2004) found that while instructional designers are conscious of their role as change agents, they lack confidence in that role and in their ability to exercise leadership. This study also found that instructional design managers tend not to understand the value of the work of instructional designers.

Keppel (2000) found that instructional designers are greatly assisted in their work by the use of various protocols, or scripts, to elicit unfamiliar information from the subject matter experts with whom they collaborate. These protocols are self-developed or shared between instructional designers; they are absent from instructional design models (Keppel, 2001). Most instructional designers in higher education lack such formal protocols for their work with online faculty.

Protocols for instructional design in higher education would make the workload more manageable and help to bolster instructional designer confidence in exercising leadership in an ambiguous role. Instructional designers work closely with faculty with whom they simultaneously function both as leaders and in a support position. In many environments, they work reactively, responding to the requests of a large number of faculty, making it hard to anticipate and set limits on a workload which can become overwhelming (Pan, Deets, Phillips & Cornell, 2003). A protocol can make it possible for the instructional designer to delegate quite a bit to the faculty member, limiting the instructional designer workload and greatly facilitating the collaboration and acquisition of needed technological skills by the faculty member. Such a protocol or script can provide the faculty member with greater control over the online course while making it possible for the instructional designer to be more available to the many faculty who may need instructional design services.

Internationally, many organizations have tried to assist online faculty with their course development through the development of online materials including learning objects and repositories for them. While large amounts of funding have been poured into these resources, these innovations have been minimally adopted by educators. Gosper et al. (2004) found that lack of the adoption of learning objects is caused by educators' not knowing how to use these resources. For online courses to attain the quality of which they are capable, there is a need the innovation of learning objects and other online resources to be diffused into higher education. Until faculty are knowledgeable enough to select online resources on their own, a protocol, or "script", would be very helpful in assisting instructional designers in guiding faculty with the process of selecting and deciding whether to make use of online digital resources

Goals

The purpose of this study was to develop a process "script" to assist college-employed instructional designers in guiding faculty with selecting online media and multimedia resources for their online courses. This process reflected the context of the online environment and the cognitive constraints associated with multimedia. It was built upon the ASSURE procedural model (**A**nalyze learners, **S**tate objectives, **S**elect methods, media and materials, **U**tilize media and materials, **R**equire learner participation, **E**valuate and revise) (Smaldino, Russell, Heinich,& Molenda, 2005) for the selection and use of educational media materials and was capable of being integrated with it. The study developed a script based upon the foundation of the research findings on media selection from the field of Instructional Design and Technology (Clark, 1999; Smaldino, Russell, Heinich, & Molenda, 2005; Reiser & Gagne, 1983; Reynolds & Anderson, 1992; and Romiszowski, 1988). As multimedia selection makes it necessary to consider issues related to cognitive load (Cohen, 2004), the script was based upon findings by Mayer and colleagues (Clark & Mayer, 2003) related to cognitive load as well.

While scripts are rarely discussed in the instructional design literature, in practice most instructional designers rely upon them to do their jobs. Keppel (2004) found that since instructional designers almost always work in unfamiliar content areas, they rely upon experts and utilize a design model consisting of a set of representations and generic strategies to accomplish their goals. These goals include eliciting needed information from the faculty subject matter expert and guiding the faculty member in the design process. The scripts inherent in such a design model simplify communication between the instructional designer and subject matter expert. Such scripts provide a "shortcut" for the instructional designer in his or her work, making it possible to accomplish goals while using less of the subject matter expert's time.

The relationship between instructional designer and subject matter expert faculty member is collaborative as they assist each other in what Keppell (2004) defines as an "elicitation/conceptualization process" that meets their mutual goals. Keppell (2001) found that instructional design models lack the conceptualization elicitation script needed by instructional designers to conceptualize the unfamiliar material presented by subject matter experts. As the development process for higher education courses containing new media can be even more complex than traditional courses (Liu, Gibby, Quiros, Demps, &

2002), and the instructional designer workload in higher education has the potential to be more demanding (Pan, Deets, Phillips & Cornell, 2003), the need for such scripts becomes even greater.

The purpose of the script developed in this study was to aid the consulting and conceptualization/elicitation process between the instructional designer and online faculty member in the area of the selection of online resources. Effective media resources take a good deal of time and skill to develop (Smaldino, Russell, Heinich, & Molenda, 2005). Selecting rather than designing quality online resources can save a great deal of time while simultaneously adding considerable value to an online course. A script to guide faculty members with the media selection process required to select online resources would greatly aid the instructional designer in his or her role of change agent (Schwier, Campbell & Kenny, 2004) diffusing the innovation of learning objects and other online resources (Friesen, 2004).

"Select methods, media and materials" is the third step of the ASSURE model (Smaldino, Russell, Heinich, & Molenda, 2005, p. 59). Included in this step is an appraisal checklist of selection criteria for each media type that begins with the question: "does it match the curriculum?". The goal of this study was to develop a script to answer this question. A process was created for the instructional designer to guide the online faculty member in finding online resources and to then determine whether they are appropriate for the curriculum. Determining whether or not a resource is appropriate for the curriculum is based on the knowledge of instructional attributes of various media and how they link to different learning outcome types. This knowledge was derived from the literature on media selection models, which have had an important place in the field of Instructional Design and Technology (Richey & Nelson, 1996).

A number of factors must be considered in the multimedia selection process. They include: (1) the learning task and the instructional conditions that facilitate the learning; (2) the characteristics of the learners; (3) the learning context and other constraints that affect the choice of medium and (4) the attributes of each medium (what each medium is capable of with regard to the three previous factors) (Smith & Ragan, 1999).

In the model of Prescriptive Instructional Science, Reigeluth, Bunderson and Merrill (1978) classified these variables as Instruction Situation Variables, Subject Matter Variables, Instructional Strategy Variables, and Instructional Outcome Variables:

- Instruction Situation Variables consist of learner type and available training resources
- Subject Matter Variables consist of domain and learning task type
- Instructional Strategy Variables consist of instructional strategies including specific attributes of multimedia presentation modes (Ellis, 2001) and
- Instructional Outcome Variables consisting of all important aspects of attractiveness, effectiveness, and efficiency of the resulting instruction.

The conditions required by the different categories of learning aid the designer in determining the attributes needed in the medium to deliver the learning. Instruction Situation Variables and Subject Matter Variables are used to prescribe the optimal parameters of the Instructional Strategy Variables. Instructional Outcome Variables result from the former three types. Based on these criteria, media selection involves narrowing media options to include only those that can achieve the kind of learning that is needed. A media selection model such as that developed by Reiser and Gagne (1983) can facilitate this analytic process (Smith & Ragan, 1999).

A media selection model is a prescriptive technique that provides a systematic and streamlined way for designers of instruction to analyze the concepts that they are endeavoring to teach, devise instructional strategies and find the corresponding media to best convey them. From the 60s through the early 90s, prior to the advent of Web-based courses, a plethora of different media selection tools were available. Reiser and Gagne (1983) cited several studies that found that the use of media selection models enabled better choices than would have been made without them.

The Reiser Gagne Model (1983) was originally developed for use in Army training, was based in solid learning theory, and underwent four cycles of formative evaluation. Reiser and Gagne based their media selection model on decisions based on attributes of media and their relationships to learning task types (Smith & Ragan, 1999).

This study retained the Reiser Gagne Model's emphasis upon media attributes and their relationship to learning task types. The product developed in the study initially worked forward and narrowed choices down as media selection models do in order to define requirements prior to the search for resources; the process then made it possible for the course design team to work backwards with the online resource itself and then answer scripted questions about whether the resource at hand was effective at delivering the appropriate kind of learning and matching the curriculum.

The study resulted in a script that made it possible for instructional designers and online faculty members to work together effectively and to efficiently evaluate online resources for a given course. It expanded faculty member knowledge of course design as they became familiar with the prescribed multimedia selection techniques. The script should bolster the confidence of instructional designers and ease their workload. And it will potentially assist with the diffusion of the innovation of learning objects and other online resources into the educational environment.

Research Questions

The study investigated the following research questions.

1. What steps are necessary to develop a process script that will help instructional designers guide online faculty in selecting online resources for their online classes?
2. What criteria set must that script satisfy in order to be considered successful?
3. What will be the best format and composition to enable the script to meet the specified criteria?
4. How can a set of criteria candidates be established?
5. How can the criteria set be validated?
6. How can the process script be evaluated?

Relevance and Significance

There is a definite need for process scripts for college-employed instructional designers to assist faculty in developing online courses and specifically to select online resources for their online courses. Over the last decade, a radical change in higher education has occurred. Many face-to-face courses have migrated for delivery over the World Wide Web (Ellis & Hafner, 2003). This new way of delivering courses can be thought of as an innovation. As with any innovation, diffusion is a complex process that takes time (Friesen, 2004). Implementation has proven to be a challenge with web-based courses. Course quality is an accurate indication of the effectiveness of implementation of web-based learning, and online course quality remains uneven. Thus it can be concluded that the diffusion of the innovation of online course delivery has not yet been completed successfully.

Much progress has been made in implementing online course delivery effectively, but much remains to be made. Evidence of progress includes the establishment of standards for quality online courses (American Distance Education Consortium, 1999) and investments in infrastructure to facilitate the development of online learning on the part of individual colleges and universities as well as government agencies. Investments on the part of colleges include the hiring of instructional designers to assist online faculty with the development of online courses and to help them understand the course development process (Torrisi-Steele and Davis, 2000). Investments on the part of government agencies include investments in online resources, specifically in learning objects, methods through which to file and access them and learning object repositories (Gosper, Woo, Gibbs, Hand, Kerr & Rich, 2004).

Yet online course quality remains uneven. Quality remains uneven because developing quality online courses requires a large knowledge base that most online faculty don't have (Ellis & Hafner, 2003). Instructional designers have an important role to play in developing this body of knowledge and as change agents and diffusers of technological innovations (Pan, Deets, Phillips & Cornell, 2003).

According to Schwier, Campbell and Kenny (2004), the instructional designer role and function is not well understood by higher education administrators. And even the field of Instructional Design and Technology that provides the existing theory underlying instructional design is inadequately grounded in instructional design practice. If the potential value of instructional designers in higher education were properly understood, then instructional designers would receive more support and the kinds of tools they need to be more effective in their jobs. Such support could enable instructional designers to make a greater contribution to the effective implementation of online learning than they do at present. Investigating the effectiveness of process scripts to assist with the instructional designer/faculty member conceptualization elicitation task was critical for improving the quality of the online course development process. Developing a script for the selection of online resources was an important element of this larger task, one whose adoption will assist with the diffusion of the innovation of online resources.

Barriers and Issues

Issues resided in several areas of the study implementation. They included the following.

Product Design

Designing the process script for online resource selection involved integrating information from many different sources from the review of the literature as well as input from the Expert Panel and feedback from formative and summative evaluation. Balancing the need for simplicity and inclusiveness has proved problematic in the design of past media selection models. Models that have included many critical selection factors have sacrificed usability, and the more usable models have included fewer selection factors (Smaldino, Russell, Heinich, & Molenda, 2005). While this was not a media selection model, many of the same issues were involved. Consequently similar decisions had to be made.

Additionally, the complexity of the instructional design task was a challenge. According to Jonassen (2002), complex instructional design problems are defined by three dimensions: the number of issues involved in the problem, the number of interactions among those issues, and the predictability of the behavior of the issues. Complex problems are more difficult to solve than simple ones. Designing the process script was complex as defined by all three dimensions.

Designing the process script was an ill-structured problem as defined by Jonassen (2002). Ill-structured problems can best be understood in contrast with well-structured problems. Well-structured problems involve applying a limited number of recently taught concepts to a well-defined problem space. Ill-structured problems are the kinds of problems that are more commonly encountered in every day practice. They often require the integration of several content domains and may have a number of solution paths. Multiple criteria can be used to evaluate the solutions to such problems. Developing this process script involved integrating concepts from several domains including educational psychology as well as the two core activities of the field of instructional design and technology, the use of media for instructional purposes and the use of systematic instructional design procedures (Reiser, 2002b). Multimedia itself is polysemous and very complex for that reason (Heller, Martin, Haneef, & Gievska-Krliu, 2001). Additionally, more than several solution paths were available, and numerous criteria were applicable to its evaluation. Consequently, the problem solving required to design this process model was ill-structured and complex.

Project Management

Skillful project management was required to coordinate the criteria validation and summative evaluation processes with the Expert Panel. It was necessary to work around the schedules of the busy and unremunerated members to result in maximum effectiveness with quick turnarounds and minimum time demands. Effectively utilizing the expertise of the Expert Panel given their disparate areas of expertise and geographic locations was an issue as well. A function such as project management which is complex in-person contains even more issues at a distance (Litchfield & Keller, 2002).

Formative Evaluation

It was necessary to effectively design sessions to result in maximum results with the least time demands upon the usability testers who were busy and unremunerated instructors and instructional designers. Under these constraints, it was also a challenge to design usability testing materials to result in maximum productive feedback and effective formative evaluation (Shneiderman, 1998).

Definition of Terms

ADDIE	ADDIE is an acronym for the key stages of the instructional design process and embodies the underlying structure of the major instructional design models. ADDIE stands for: Analysis, Design, Development, Implementation, and Evaluation (Lohr, 2003).

ASSURE model	The ASSURE model (Smaldino, Russell, Heinich, & Molenda, 2005) is an instructional design model that leads the designer through the entire instructional design process and deals extensively with media selection. ASSURE is an acronym for **A**nalyze learners; **S**tate objectives; **S**elect methods, media and materials; **U**tilize media and materials; **R**equire learner participation; and **E**valuate and revise. A process for planning and delivering instruction, ASSURE is oriented toward classroom use.
Cognitive load	Cognitive load is the amount of mental resource required by a task (Clark & Mayer, 2003).
Instructional strategy	An instructional strategy, also known as an instructional method, is based on a decision about how information should best be presented or taught. It is derived from the analysis of learner, task and context that preceded it (Lohr, 2003). Examples of strategies include presentation, demonstration, tutorial, drill-and-practice, gaming, simulation, discovery, problem solving and case study.
Learning object	Learning objects have several definitions. The IEEE definition developed during the standardization process (IEEE, cited in Conole, 2002, p. 5) is: “A learning object is any entity, digital or non-digital, which can be used, re-

	used and referenced during technology-supported teaching”.
	The most common definition of a learning object as presented in Johnson (2003, p. 8) is: “A collection of digital materials – pictures, documents, simulations – coupled with a clear or measurable learning objective or designed to support a learning process”.
Learning outcome	Learning outcomes, also known as learning objectives and learning goals, are clear descriptions of what capabilities learners will possess as a result of instruction (Smith & Ragan, 1999). Theorists have identified different categories to which learning outcomes can belong.
Learning outcome category	Learning outcomes belong to different categories depending upon the capabilities made possible by the instruction. Learning outcome categories as defined by Gagne, Briggs and Wager (1992) include intellectual skills, cognitive strategies, verbal information, motor skills, and attitudes.
Media	A medium is a channel of communication that carries information between a source, such as a computer, and a receiver, such as a learner (Smaldino, Russell, Heinich, & Molenda, 2005). The term “media” is the plural of “medium”. Media have also been defined as the physical

	means for presenting stimuli to a receiver (Briggs & Wager 1981). Salomon (1981) defined media as modes of expression and communication, based on technologies, that result in new symbol systems or new blends of symbol systems. Examples of media include still images, such as photos, slides and graphics; video such as full motion video, time lapse, and montage; and audio, such as music, sound effects, and narration.
Media attribute	A media attribute is the potential of a given medium to present information of a certain kind (Jonassen, 2001).
Multimedia	The combination of two or more media comprise multimedia (Clark & Mayer, 2003).

Assumptions, Limitations and Delimitations

Assumptions

It was assumed that members of the Expert Panel would have sufficient expertise to make substantiative contributions and that they would share freely of their expertise as they engaged in the designated tasks of criteria validation and summative review. It was necessary for them to be available and to respond in a timely manner. Another assumption was that subjects in the study would apply themselves fully to completing the assigned tasks and would be forthcoming about their reactions to and experience of using the process script.

It was assumed that the findings related to the instructional attributes of media in pre-web based learning were for the most part applicable to their use on the web. Where obvious differences existed, for example with video that displays much smaller and with degraded quality over the internet, an equivalency was not assumed.

Limitations

All members of the Expert Panel and usability and field testers were volunteers and could withdraw at any time. The Expert Panel was comprised of instructional designers who provided feedback. Formative evaluation participants were representative of the typical end users identified for the process script for online resource selection, instructional designers and online faculty. These participants were drawn from volunteers who were professional freelance instructional designers and from the faculty of Portland State University (PSU), the Pacific Northwest College of Art (PNCA), and the Blosser Center for Dyslexia Resources; PSU is a large university, PNCA is a small urban four-year college, and the Blosser Center is a small nonprofit organization located in Portland, Oregon that offers training to educators. The classes offered by the Blosser Center are currently completely face to face. They have not yet transitioned to providing any online classes, but they would like to do so to reach potential students in remote areas.

Online resource selection takes place in the design phase of the instructional design process. The process script developed in this study was for use in the design phase and Step 3 of the ASSURE model. The course development steps in the analysis phase and Steps 1 and 2 of the ASSURE model were a necessary prerequisite for use of the model. This prerequisite training was supplied to online faculty who participated in this study.

Delimitations

This study was restricted to higher education online course development situations where an instructional designer and online faculty member collaborate to develop a course. While all online course development does not occur this way, the purpose of this study was to explore the instructional designer/faculty member collaboration and conceptualization/elicitation process.

This study was restricted to situations where the faculty developer was also teaching the course. It was not applicable to self-paced instruction.

The literature review of cognitive factors related to educational multimedia was limited to findings related to cognitive load. Cognitive load issues, including overcoming the limits of working memory, are some of the most important cognitive factors to consider when selecting online resources (Samaras, Giouvanikis, Bousio &Tarabanis, 2004).

This model assumed that the learners had average or above reading and writing skills, commonly thought to be a prerequisite for successfully taking online courses.

Summary

This chapter has included the following sections: Problem Statement; Goals; Relevance and Significance; Research Questions; Definition of Terms; Barriers and Issues; and Assumptions, Limitations, and Delimitations.

The problems to be addressed by this study were threefold. They included the lack of online pedagogical skills possessed by many online faculty and the ineffective implementation of two solutions currently in place to address this problem: (1) the lack of educator adoption of online resources such as learning objects for their classes and (2) the need for better processes for college-employed professional instructional designers to work with online faculty.

The goals of this developmental study were to develop and test a process “script” to assist instructional designers in guiding faculty with the selection of online media and multimedia resources for classes that they were designing. The Online Resource Selection Instructional Design Script (ORSIDS) that was developed in this study served as part of the elicitation-conceptualization process to facilitate the instructional designer/online faculty member collaboration. The script was based upon the foundation of research findings on media selection from the field of Instructional Design and Technology. It also included issues of cognitive load necessary to consider with multimedia.

The relevance and significance of this study resided with its potential to improve the implementation of online course design practices. Diffusion of the innovation of online course design has not yet been completed successfully. Professional instructional designers have a potentially greater role to play in the successful diffusion of online course design, but obstacles have kept them from operating in as successful a manner as is possible. There has been a lack of understanding of the instructional designer role by college administrators, and instructional design models have been inadequately grounded in practice. If the instructional designer role was better understood and supported, instructional designers could provide more value as change agents in effectively diffusing the innovation of online course design.

Barriers and issues related to this dissertation study included the complexity of the design task and potential project management difficulties with managing an expert panel review via distance.

Future chapters of this final report provide a Review of the Literature; Methodology; Results; Conclusion, Implications, Recommendations and Summary, and Back Matter consisting of Appendixes and a Reference List.

Chapter 2

Review of the Literature

Introduction

This study investigated the efficacy of the use of a process script for online resource selection for online courses. The scenario for the use of such a script is the elicitation/conceptualization process that occurs between professional instructional designer and online faculty member when collaborating in the development of an online course. The larger context for this scenario is that of an instructional designer/online faculty member relationship in which the instructional designer serves as change agent, guiding the development of instructional materials while simultaneously diffusing technology into the teaching practice of online faculty members. In this ideal instructional designer/online faculty member relationship, faculty members learn the instructional process, growing in time to be able to take increasing responsibility for the development of online materials until they are completely independent. The specific technology diffused by the professional instructional designer in this scenario consists of learning objects and other online digital resources.

The many topics touched upon in this review of literature include:

- *Online learning pedagogy*, to introduce the range of skills necessary to design and deliver courses presented online by an online faculty member

- *E-learning*, to introduce the specific instructional media elements that the use of online resources can make available. An online course does not need to provide such elements to be effective, but under the right circumstances, such digital resources can add a great deal of value to an online course.
- *Instructional design*, a process which facilitates the design of quality online courses. Media selection, including the selection of online resources, is an important step in the instructional design process.
- *Instructional designers*, to introduce the role of the professional instructional designer in higher education and to focus particularly upon the instructional designer/online faculty member relationship.
- *Online educational resources, including learning objects,* to discuss the availability of such resources and their potential value in online courses. This section also deals with reasons for the lack of integration of online resources into educational environments and some possible ways to overcome educator resistance to their use.
- The educational uses and instructional attributes of *media and multimedia*. Since online resources are composed of media and multimedia, an understanding of these areas is critical in making good selection choices.
- *Media selection* and *media selection models*, to introduce the foundational work in media selection preceding the advent of e-learning. These approaches have value for today's online resource selection. They supply many of the criteria upon which online resources should be selected for inclusion in online courses.
- *Multimedia*, the format in which many online resources display. This section discusses how multimedia selection differs from media selection because issues of

cognitive load must be considered. This section also discusses cognitive learning theory and information processing theory, educational theories that explain how people learn.

Online Learning Pedagogy

Teaching online means conducting a course partially or entirely through the Internet (Ko & Rossen, 2001). Because of the absence of physical presence, the online environment differs in many ways from that found in the traditional classroom. Online group dynamics are very different and need to be acknowledged for instruction to be effective (Lee, 2000; Palloff & Pratt, 2001; Schopler, Abell & Galinsky, 1998). The online environment radically alters patterns of communication between instructor and students (Warschauer, 1999; Wegerif, 1998). Additionally, the instructor must be much more explicit in his or her communications because misunderstandings are not as easily clarified online as in person (Galinsky, Schopler & Abell, 1997). Because of the absence of visual and auditory cues, text becomes far more important in instructor/student communication as is the necessity for the instructor to be able to both interpret and deliver discourse skillfully (Collison, 2000; Warschauer, 1999; Wegerif, 1998). In fact, the nature of discourse itself becomes altered in the online educational environment because it now serves a different purpose and functions within a different environment than before (Warschauer, 1999; Wegerif, 1998).

Furthermore, the very nature of the newness of the endeavor of online education can easily result in confusion for instructor and students. Students are often confused about what their role is to be in this new domain (Dringus, 2000). Instructors, too, are often confused about their new role, balancing facilitative approaches with the necessity to maintain a role of educational leadership.

Additionally instructors must be aware of the resources on the internet that can be used to teach their specific subject area – and applicable topics within it (Wallace, 2004). They must be knowledgeable about how best to employ these online resources to serve their pedagogical purposes.

Online learning has great potential for providing an improvement over what is commonly found in the classroom. Kearsley (2000) wrote of intrinsic qualities of online learning that can lead to higher quality: authenticity, student centeredness, and the potential to be more humane and personal. Palloff and Pratt (2001) focused on the student autonomy inherent in online learning as well as constructivism and collaborative thought that they state can yield deeper levels of knowledge creation.

Because it is so radically different, the ability to teach in this way clearly requires the acquisition of new techniques, some of which have been written about and some of which are still being discovered (Buchanan, 1999; Stanberry 2000; University of Illinois, 1999). On-line pedagogy as discussed in recent literature enables the instructor to skillfully facilitate the students' networking activities, gives the instructor an important role in moderating interaction, highlights the importance of both writing and analyzing the written interactions of others, and requires the teaching paradigm to change from the traditional lecture format. The instructor must actively guide on-line discourse in a caring, stimulating manner and must use a variety of techniques to enliven the courses. Unlike face-to-face education, online courses must function so that students can work independently of the instructor, interacting with courses remotely and asynchronously

(Ko & Rossen, 2001; Palloff & Pratt, 2001). The online instructor must have the ability to facilitate a virtual classroom and must change the method of teaching to give more attention to advanced preparation, student interaction, visual materials, activities for independent study, and follow up activities. Designing courses online requires a change in the faculty role from that of instructor to that of course designer (Davidson-Shivers, 2002).

E-Learning

Clark and Mayer (2003) defined e-learning as instruction delivered on a computer via Internet, Intranet or CDROM which contains the following attributes:

- Use of instructional methods such as practice and examples to help learning
- Use of media elements such as words and pictures to deliver content and methods
- Including content relative to learning objectives

All online courses are not e-learning, nor are all e-learning courses online. An e-learning course without instructor mediation or that is delivered solely via CDROM is not an online course. An online course that is only text based and/or does not contain opportunities for practice is not e-learning. However, well-designed online learning includes e-learning features when appropriate (Clark & Mayer, 2003). Knowledgeable faculty are able to implement e-learning affordances such as media elements and practice opportunities. Such learning affordances are costly and time consuming to design and produce. However, online resources exist, making it possible for faculty to select such media assets rather than designing them.

Online faculty must thus possess the ability to implement e-learning features. Many faculty currently do not. The ability to implement computer-based instructional strategies that are compatible with how people learn is also necessary (Clark, 1999). Knowledge of the craft of instructional design makes these skills possible (Reiser, 2002).

The Instructional Design Process

Instructional design is a system of methods for systematically planning, developing, evaluating and managing the instructional process to ensure that students learn effectively (Smith & Ragan, 1999). Instructional design focuses upon the needs of the learner, consisting of processes for designing instruction that are based on sound practices (Morrison, Ross & Kemp, 2001). Ideally, these practices are derived from research about learning theory and instructional technology (Rouet, 2002). Several characteristics tend to be present in effective instructional design efforts:

- Learner centeredness
- Goal orientation
- Focus on real-world performance
- Data collection throughout the process
- Team effort
- Measurable outcomes (Gustafson & Branch, 2002b).

This section of the Review of Literature focuses upon models that help practitioners to understand and implement the instructional design process. Other sections of the Review of Literature present additional related theories from the field of Instructional Design and Technology.

Instructional Design Models

Instructional design models assist people in creating instruction by helping them to visualize the steps necessary to execute the instructional design process. They provide guidance for how to conduct the instructional design task. Gustafson and Branch (2002a) divided instructional design models into three categories: *classroom* oriented, *product* oriented, and *system* oriented.

- Classroom models are of use to professional teachers in a classroom context
- Product models help with the development of technically sophisticated products that are several hours or perhaps several days in length
- System models assume that a large amount of technically sophisticated material will be developed by a team of highly trained developers with access to considerable resources

It should be noted that while there are perhaps hundreds of instructional design models, there are not that many true differences among them. A model is a simple representation of forms, functions and processes that in reality are more complex (Gustafson & Branch, 2002a). Instructional design models are useful because they help to conceptualize representations of reality. However, as applied to instructional design practice, instructional design models have limits that need to be acknowledged. Very little testing of models has been reported in the literature; it is possible that many have never actually been used (Gustafson & Branch, 2002a). Most professional instructional designers rarely refer to instructional design models. They introduce many variations to execution of the instructional design process and as appropriate may eliminate or substantially alter one or more phases of the process described by the models.

The ADDIE Model

ADDIE is an acronym for the key stages of the instructional design process and embodies the underlying structure of the major models (Lohr, 2003). The ADDIE Model is a generic instructional design model. It is important to note that the ADDIE activities do not actually take place in a linear manner, even though the models often present them in that way for the sake of clarity (Gustafson & Branch, 2002a). ADDIE stands for:

- ***Analysis*** **–** of elements including learners, learning goals, and required skills
- ***Design*** **–** of performance objectives and instructional strategies
- ***Development*** **–** of materials, including media selection and design of media characteristics
- ***Implementation*** – of instructional materials delivery
- ***Evaluation*** **–** formative and summative assessment of learner performance

In the *Analysis* phase, needs assessment, determination of learner characteristics, and task and instructional analysis take place. Task analysis determines the operational components of a job, skill or subject matter to determine what expert performers do and how they think. Task analysis answers the question of what the job or content consists of through the following means:

- A task inventory listing the general duties or topics making up the job or content
- A task description elaborating upon the duties or topics in order to identify the tasks, subtasks, information flow and knowledge base necessary to perform a job or use the content

In contrast, the instructional analysis asks what must be learned in order to accomplish the following:

- To eliminate tasks that are not the subject of the instruction
- To determine the types of learning that must be acquired by analyzing task and content levels
- To determine the order in which learning will occur by sequencing tasks and content (Seels & Glasgow, 1998).

Analysis is also the phase where one determines if an identified problem can be solved with an educational intervention.

Discoveries from the Analysis phase serve as the foundation for the *Design* phase. In the Design phase, decisions about how the content should be taught and presented are made. Particularly critical are the formulation of learning objectives and instructional strategies. *Learning objectives,* also known as *learning goals* and *learning outcomes*, are clear descriptions of what capabilities learners will possess as a result of instruction (Smith & Ragan, 1999). Theorists including Clark (1999), Djikstra (2003), and Gagne, Briggs & Wager (1992) have identified different categories to which learning objectives, or outcomes, can belong. To ensure that all learning types were covered, this study utilized the learning outcome categories of Gagne, the most widely accepted learning outcome categories and the categories on which media selection research is based (Ragan & Smith, 1996) supplemented by the aesthetic category of Romiszowski (1988). Determining the learning category of a learning objective facilitates the process of devising an instructional strategy. Learning objectives can be determined at the course, unit, and lesson level.

An *instructional strategy*, also known as an *instructional method*, is based on a decision about how information should best be presented or taught. The instructional strategy is developed by deciding the content that should be presented, how it should be presented, and the sequencing of the instruction (Smith & Ragan, 1999). It is derived from the analysis of learner, task and context that preceded it (Lohr, 2003). Examples of strategies include presentation, demonstration, tutorial, drill-and-practice, gaming, simulation, discovery, problem solving and case study (Belanger & Jordan, 2000; Smaldino, Russell, Heinich, & Molenda, 2005). Many factors affect the choice of instructional strategy. The overriding concern is to select a strategy that best supports the student's learning within the educational context. The import of instructional strategies cannot be overemphasized. If delivered with media and instructional message design that do not impede effectiveness, learning efficacy is actually determined by the instructional strategy (Smith & Ragan, 1999). It is in the Design Phase that media are selected and media characteristics are designed.

Decisions from the Analysis and Design phases are manifested in the *Development* phase. The decisions and specifications made earlier in the instructional design process are translated here into the materials used by the learner (Seels & Richey, 1994). In this phase, the instructional materials themselves are produced. Instructional materials are developed; storyboards, scripts and code are created; visuals are implemented; and instructional messages are designed. The materials produced in the Development phase probably fall into one of the categories that make up the majority of instructional materials developed today including print-, computer- and computer-based multimedia, video-, and teacher-based instruction (Smith & Ragan, 1999).

Different activities occur depending upon which medium is being produced. Each of these domains is very specialized, with volumes dedicated to the design, production and implementation of each. The development domain is comprised by the content-driven *message*, the theory-driven *instructional strategy*, and the hardware, software and/or instructional materials that are the physical manifestation of the technology in use. Technology is the driving force of the Development phase (Seels & Richey, 1994). Tryouts of the materials with representative learners, also known as formative evaluation, should be an important part of the Development Phase (Reynolds & Anderson, 1992). Instructional materials should not be finalized until formative evaluation has been successfully completed.

Realistic and detailed planning for the implementation and management of the instruction takes place in the *Implementation* Phase. In this phase the nuts and bolts of how the training will actually be delivered is determined and executed. Implementation is defined as the use of instructional materials or strategies in real, rather than simulated, situations (Seels & Richey, 1994). The purpose of implementation is to ensure proper use of the instruction by individuals within an organization. Decisions are made regarding delivery platforms and resources. Rooms and resources are scheduled, instructors are assigned, and students are enrolled. In some environments, marketing strategies will be implemented. Sometimes, changes in individuals and their organizations may be necessary for implementation to be successful. The research base for implementation is not as well developed as the other areas (Seels & Richey, 1994).

In the *Evaluation* Phase, the product is tested for instructional effectiveness. There are actually two major kinds of evaluations that occur at different times in the development process and for different purposes: formative and summative evaluations (Smith & Ragan, 1999; Stake, 1983). *Formative evaluations* occur at key phases during design and development to ensure that the materials meet stakeholder objectives and that they will be effective. To avoid major costs, the instruction is ideally tried out with representative learners as early on in the development process as reasonable and before being produced in mass quantity. In contrast, *summative evaluation* is conducted after materials have been implemented to enable decisions regarding effectiveness. A summative evaluation makes it possible for decision makers to decide whether to adopt or continue to use materials, and if so, under what conditions. A summative evaluation is usually conducted by management, occurring outside of the instructional design process (Dick, Carey & Carey, 2000).

There are three types of formative evaluation: one-to-one, small-group, and field trials (Dick, Carey & Carey, 2000). In *one-to-one evaluations,* the designer gathers feedback from individual learners on ways to improve the materials. In a *small group evaluation*, learners representative of the target population study the materials on their own; then the necessary feedback is compiled through testing. A *field trial* consists of testing the instruction in as life-like a situation as possible.

Different kinds of formative evaluation also occur depending upon the type of media being produced. An evaluation of readability is one type of formative evaluation that can be done with text-based materials, either print or computer-based (Smith & Ragan, 1999). Readability determines the level of reading ability needed to comprehend the specified text material. A readability evaluation makes it possible to gauge whether the given text level is appropriate for the targeted learners. Computer-related materials require testing to ensure that the materials are working as anticipated and that learners can navigate them without difficulty.

The Influence of Robert Gagne Upon Instructional Design

Robert Gagne (1992) contributed many seminal principles to the instructional design process. Many of today's leading instructional design models are based upon his conditions-of-learning theory (Gagne, Briggs & Wager, 1992; Ragan & Smith, 1996). Gagne defined the purpose of instructional design theory as that of proposing a rationally based relationship between instructional events, their effects on learning processes, and the learning outcomes produced as a result of these processes. The influence of this perspective is found in the task analysis, strategy development, and assessment and evaluation procedures of instructional design models.

According to conditions-based models, when designing instructional strategies, instructional designers must determine the goals of instruction, categorize the goals as to learning outcome category, and select strategies that have been suggested as effective for this category of learning outcome. Gagne discussed the internal and external conditions of learning that support each type of learning objective. Internal conditions are cognitive processes supporting the acquisition of particular categories of learning outcomes while external conditions are those instructional conditions provided by teacher, materials, or other learners that can facilitate the internal conditions necessary for learning. These external conditions vary according to type of learning.

Current Instructional Design Models

Lohr (2003) and Bond-Hu and Spector (2002) suggested that today's leading instructional design models include those of Dick, Carey & Carey (2000), Smith &

Ragan (1999) and Morrison, Ross & Kemp (2001). Beginning instructional design courses usually use one or more of the texts based on these models because they provide an effective means of introducing the instructional design process to novice designers.

The Dick & Carey Model. Dick and Carey's Systems Approach Model for Designing Instruction (Dick, Carey & Carey, 2000) was the most widely used textbook in the classroom according to a 2000 poll (Bond-Hu & Spector, 2002) and is an excellent introduction for novice instructional designers. It reflects the basic instructional design process used in business, government and the military, and reflects the influences of performance technology and application of computers to instruction (Gustafson & Branch, 2002a).

The model contains the following iterative steps:

I. Assess needs to identify goals

IIA. Conduct instructional analysis

IIB. Analyze learners and contexts

III. Write performance objectives

IV. Develop assessment instruments

V. Develop instructional strategy

VI. Develop and select instructional materials

VII. Design and conduct formative evaluation

VIII. Revise instruction

While the model is very detailed in describing the necessary analysis steps, later steps from the Design phase on are far less specific, leaving room for the individual instructional designer to strategize as required by the situation and type of instruction being designed. The iterative nature of the instructional design process is apparent from the model. Outstanding features of the model include the following:

- It is a systems model that can also be applied to specific products
- The step of *constructing the instructional analysis* is very detailed and specific, influenced by and extending the work of Gagne
- The step of *develop and select materials* includes the processes of both development and selection, but development is the authors' clear preference. It discusses media selection as part of this process.
- Substantial guidance in evaluation is provided. However, the authors make clear that summative evaluation occurs separately from the instructional design process (Gustafson & Branch, 2002a).

The Smith & Ragan Model. The Smith & Ragan Model (Smith & Ragan, 1999) is another good introduction for beginners and accommodates the needs of professionals within the field as well. It, too, presents a general systems model for instructional design. It assigns three major stages to the instructional design process: Analysis, Strategy, and Evaluation. In Analysis, learning contexts, learners, and the learning task are analyzed before test items are written. After organizational, delivery and management strategies are determined in the Strategy phase, the instruction is written and produced. Formative evaluation is conducted in the Evaluation phase prior to revision of the instruction.

Though this model focuses upon the cognitive psychology base of the instructional design process, it sets up the topic with a discussion of the paradigm shift within the field from behaviorist concepts. The model emphasizes the design of instructional strategies for different kinds of learning outcomes (Gustafson & Branch, 2002a). One of the model's strengths is its presentation of the theory and philosophy behind the systematic design of instruction. The book discusses media selection in some detail. This model, too, was heavily influenced by Gagne.

The Morrison, Ross & Kemp Model. The Morrison, Ross & Kemp model (Morrison, Ross & Kemp, 2001) is one of the few that has been altered over time, initially reflecting more of a classroom emphasis and now more of a focus on corporate applications (Bond-Hu & Spector, 2002; Gustafson & Branch, 2002a). This model ranked second in use in the classroom, below Dick and Carey (2000), according to a 2000 poll. This model claims to utilize an approach in which the learner rather than the content is the focus of curriculum planning. The model focuses upon the following key factors:

- What level of readiness do individual learners have for accomplishing the objectives?
- What teaching and learning methods are most appropriate for the objectives and student characteristics?
- What media or other resources are most suitable?
- What support, beyond the teacher and available resources, is needed for successful learning?
- How is achievement of objectives determined?
- What revisions are necessary if a pilot of the program does not meet the expectations?

While this textbook does not deal with media design or selection, it does deal with the selection of media resources.

Instructional Design Models that Deal with Media Selection. The ASSURE model (Smaldino, Russell, Heinich, & Molenda, 2005) and the Briggs and Wager model (1981) are two instructional design models that lead the designer through the entire instructional design process and deal extensively with media selection. ASSURE is an acronym for **A**nalyze learners; **S**tate objectives; **S**elect methods, media and materials; **U**tilize media and materials; **R**equire learner participation; and **E**valuate and revise. A process for planning and delivering instruction, it is oriented toward classroom use and makes the important point that in the busy world of the classroom teacher, it is advantageous to select materials rather than design or modify them. The Briggs and Wager model is very thorough, including many considerations necessary for media selection. Both instructional design models are discussed in greater detail within the Media Selection Model section of this Review of Literature.

Instructional Design Models and Resource Selection

The selection of media and/or resources comprised of media plays an important role in all of the instructional design models described here. Media selection is part of the Design phase in which the “how” of instructional delivery is determined. It follows the Analysis phase in which instructional needs are assessed, and precedes the Development phase in which the instruction is actually created, the Implementation phase in which the instruction is delivered, and the Evaluation phase in which the effectiveness and suitability of the instruction are assessed.

All of the instructional design models discussed here specify that resource selection takes place at a certain stage in the instructional development cycle, but they lack specificity on how it has occurred and should occur in the context of the higher education instructional designer/online faculty member relationship.

Schwier, Campbell & Kenny (2004) found that instructional design models are not grounded in the practice of instructional designers working in higher education and should be more reflective of what instructional designers actually do. Keppel (2001) found that the critical elicitation/conceptualization process used by instructional designers to efficiently gather needed information from the subject matter experts with whom they work is not reflected in instructional design models or anywhere in the literature. Thus many gaps exist in instructional design literature that need to be addressed by today's researchers, specifically relating to instructional design practice as it is and as it should be in higher education.

Instructional Designers

Because the design and development of online courses and environments requires considerable skill and knowledgeable planning (Ellis & Hafner, 2003), instructional designers are increasingly being hired to work in colleges and universities (Pan, Deets, Phillips & Cornell, 2003). The instructional designer function in higher education is two-fold: instructional designers (1) design and develop online course materials and (2) facilitate changes in how academics think about teaching and learning (Torrisi-Steele & Davis, 2000).

The instructional designer role of higher education change agent is an important one (Schwier, Campbell & Kenny, 2004). Essentially, the instructional designer facilitates innovation in colleges and universities through taking an active role in the professional development of teaching staff, enabling them to develop skills to produce online courses and to teach online (Torrisi-Steele & Davis, 2000). This instructional designer role includes introducing faculty to online resources.

What Instructional Designers Do

The instructional designer translates the needs of the client, or faculty member, into a plan to produce a product to meet that client's needs (Liu, Gibby, Quiros & Demps, 2002). The instructional designer guides the client through the design process, eliciting needed information and providing the necessary information to the client to enable him or her to make the correct design decisions. Instructional designers are essentially problem solvers who invent solutions as a routine part of their work (Schwier, Campbell & Kenny, 2004). Because the instructional designer has knowledge of both technology and educational needs, his or her communication skills make it possible to serve as a bridge between technological innovations and the educator (Liu, Gibby, Quiros, Demps, 2002).

The main goal of the instructional designer is to select, sequence, and synthesize content for instructional purposes and develop a desired product without, in most cases, previous content expertise (Keppell, 2001). A core function of the instructional designer is to apply his or her skills to *other disciplines*. Keppell (2004) found that the instructional design role is similar to that of an anthropologist going into different cultures. He found that within a college, each faculty has its own boundaries of practice and culture.

Since instructional designers almost always work in unfamiliar content areas, Keppell (2004) found that they rely upon experts and utilize a design model consisting of a set of representations and generic strategies to accomplish their goals.

> Instructional designers are process oriented individuals who have a set of representations based on a "design model". The design model can be seen as analogous to a script, a knowledge packet in memory which allows us to understand routine activities. The designer has a generic script which can be applied with variations to new educational problems. There are a number of generic skills that instructional designers must have to work in unfamiliar content areas (Keppell, 2004, p. 3613).

The scripts inherent in such a design model simplify communication between the instructional designer and subject matter expert, provide a "shortcut" for the instructional designer in his or her work, and make it possible to accomplish goals while using less of the subject matter expert's time.

Schwier, Campbell & Kenny (2004) found that instructional design is a profession striving for identity, a positive image and respect. The clients with whom they work and the administration above them often neither understand nor recognize the value of the instructional designer contribution. Instructional designers have an ambiguous role in relation both to their clients and to their managers. They simultaneously provide leadership to and support (and are subservient to) faculty members (Pan, Deets, Phillips & Cornell, 2003). While instructional designers serve as change agents, *it is not they who set the agenda for change* but the managers above them (Schwier, Campbell & Kenny, 2004). Some of the changes on the management agenda connected with online course delivery erode traditional academic rights. Ellis, Hafner and Mitropoulos (2004) found that many faculty associate professional instructional designers with concerns related to academic freedom and intellectual property and display reluctance to engage in collaborations with instructional designers for those reasons.

The Relationship Between Instructional Designers and Faculty

As instructional designers work in unfamiliar content areas, they rely upon the assistance of experts, otherwise known as Subject Matter Experts (SMEs). In the higher education environment, it is the faculty member who serves as SME. Managing this relationship is one of the more difficult aspects of the job of the instructional designer. Ideally the relationship is collaborative as instructional designer and subject matter expert assist each other in what Keppell (2004) defines as an "elicitation/conceptualization process" to gather and articulate the necessary information to meet their mutual work goals. The instructional designer, as the team member who is familiar with the process of creating educational materials, is responsible for providing leadership in the design process. The instructional designer must clarify the subject matter expert expectations about the role he or she must play and the commitment that is necessary for the project to succeed.

When working in higher education, this relationship takes on an additional dimension. Now, in addition to developing instructional materials, the instructional designer becomes responsible for consulting with faculty to facilitate their literacy in instructional technology (Pan, Deets, Phillips & Cornell, 2003). As faculty become more literate, they can take on more responsibility for the design and development of their courses. For an instructional designer servicing numerous faculty, it can be hard to forecast how many courses they will require assistance with and what level of assistance will be needed. In this situation, the instructional design workload can become amorphous bordering on the unmanageable (Pan, Deets, Phillips & Cornell, 2003).

What's Missing from the Literature on Instructional Designers?

Schwier, Campbell & Kenny (2004) found that instructional design models and theories were not grounded in practice. As they were not drawn from the experiences of instructional designers, such models were not sensitive to the factors that affect designer decisions and did not reflect the selective completion of activities that actually occurs. For that reason, these authors viewed instructional design models and theories as incompatible with instructional design practice.

Keppell (2001) found that instructional design models lack the conceptualization elicitation script needed by instructional designers to conceptualize the unfamiliar material presented by subject matter experts. As higher education courses containing new media are even more complex than traditional courses (Liu, Gibby, Quiros, Demps, 2002), and the instructional designer workload is more demanding (Pan, Deets, Phillips & Cornell, 2003), the need for such scripts becomes even greater.

Online Educational Resources, Including Learning Objects

Many educational resources exist online. Online instructors can incorporate them into their classes for use with a wide range of teaching activities. Such online resources include digital materials displayed on websites such as the PBS site accompanying the Ken Burns jazz series (http:www.pbs.org/jazz/lounge/) to more structured environments and data stores including managed and virtual learning environments and digital libraries as well as information gateways and portals (Conole, 2002). The Multimedia Educational Resources for Learning and On-Line Teaching (MERLOT) (http:www.merlot.org/help/FAQ.po) is a national gateway to web-based peer-reviewed learning materials and a successful demonstration project (Johnson, 2003). Learning object repositories are another example of online searchable collections of digital educational resources that are available online (Boyle, 2002).

Learning objects have several definitions. The IEEE definition developed during the standardization process (IEEE, cited in Conole, 2002, p. 5) was “a learning object is any entity, digital or non-digital, which can be used, re-used and referenced during technology-supported teaching”. The most common definition of a learning object as presented in Johnson (2003, p. 8) is “a collection of digital materials – pictures, documents, simulations – coupled with a clear or measurable learning objective or designed to support a learning process”.

While quality online resources can add a great deal to an online course, they are expensive and time consuming to produce. Designing such materials is outside of the scope of what most individual instructors can reasonably be expected to do as part of their routine workload.

To facilitate the development and sharing of such resources, governments around the world have spent large sums of money on initiatives to develop learning objects, methods through which to file and search them (metadata), and online repositories in which to store them (Friesen, 2004). However, there has been a general lack of adoption of learning objects and repositories for them.

Gosper et al. (2004) found that a major reason for the reluctance of educators to share and reuse these objects is a lack of understanding of how such objects can apply to the learning outcomes they plan to achieve. Additionally methods through which to customize the objects and the applicable copyrights are hard to understand. Friesen

(2004) compared educator resistance to learning objects with other technology-originated innovations introduced into educational settings. He wrote that the problem with such innovations resulted from the fact that such innovations are introduced “bearing the stamp” of their technical origins rather than in terms meaningful to educators. Yet when educators appear to resist such innovations, they are blamed for not readily adapting to them. Friesen cited Rogers (1962) who found that the rate of adoption of innovations by educators increased significantly when the innovations display simplicity, compatibility with the practices of the environment, and apparent advantages as compared with “business as usual”. Thus the provision of learning objects and related infrastructure alone will not lead to their adoption (Gosper et al., 2004). A bridge needs to be created enabling educators to understand their use.

Johnson (2003) found that an enabler of educational learning object use included learning design, or the theories and techniques of teaching and learning that ensure successful learning outcomes. The finding was that while such a body of knowledge exists and is sufficient, it is not widely understood. To make the circumstances surrounding the use of learning objects and other online educational resources more favorable for adoption, such knowledge must be disseminated. Instructional designers are perfectly situated to disseminate this information. Knowledgeable about learning theory and in the use of technology, skilled communicators who are familiar with the needs of educators and the higher education context, the instructional designer is well equipped to serve as a bridge between available technology and its use by educators.

Media

Online educational resources appear as media and multimedia. A medium is a channel of communication that carries information between a source, such as a computer, and a receiver, such as a learner (Smaldino, Russell, Heinich, & Molenda, 2005). Media have also been defined as the physical means for presenting stimuli to a receiver (Briggs & Wager 1981). Salomon (1981) defined media as modes of expression and communication, based on technologies, that result in new symbol systems or new blends of symbol systems. Examples of media include still images, such as photos, slides and graphics; video such as full motion video, time lapse, and montage; and audio, such as music, sound effects, and narration.

Media are considered *instructional media* when they carry messages with an instructional purpose. Clark and Mayer (2003) defined media elements as auditory and visual techniques used to deliver instructional strategies (Clark & Mayer, 2003). They present words and illustrations and can consist of formats including text, narration, music, still graphics, photos, animation, and video. Different media have characteristics that make them more suitable to deliver certain strategies (Clark & Mayer, 2003); these characteristics are known as attributes.

In thinking about instructional media, it is important to distinguish between the media themselves and the messages, or the instructional strategies, that the media are used to implement. Some examples of instructional strategies include presentation, demonstration, drill-and-practice, tutorial, gaming, simulation, discovery and problem solving (Smaldino, Russell, Heinich, & Molenda, 2005).

This dissertation study refers to both *media* and *multimedia.* The distinction is as follows: the term media is used when a single communication channel (such as a graphic) is being referred to; the term multimedia is used when a combination of two or more such channels, such as a graphic combined with narration, is being discussed.

Why Use Media and Multimedia for Education?

Media and multimedia can be difficult to implement in an educational setting. Developing media is time consuming, costly, and requires specialized skills unavailable in many university settings. In an online setting, the computer systems of many learners may not be sophisticated enough to receive and deliver media assets properly (Abramson, 1998). Furthermore, based on surveys of the effectiveness of dated multimedia/hypermedia applications ("dated" referring to applications from the mid-1990s and earlier), some critics claimed that media-based software can actually be detrimental to learning (Dillon & Gabbard, 1998). Additionally, researchers who deal with cognitive load issues stated that learning can actually be depressed by the use of e-learning’s technological capabilities to simultaneously deliver text, audio and video if designed unskillfully (Clark & Mayer, 2003; Samaras, Giouvanakis, Bousiou and Tarabanis, 2004). Poorly designed multimedia can place too much of a processing burden on the learner, interfering with the learning process (Sweller & Cooper, 1985). But there are also many arguments that support the use of well designed media and multimedia.

Researchers reported that when designed and delivered knowledgeably, multimedia presentations encourage active learning by mentally representing material in words and pictures (Clark & Mayer, 2003). Across ten studies (Mayer, 1989b; Mayer and

Anderson, 1991; 1992; Mayer, Bove, Bryman, Mars, and Tapangco, 1996; Mayer and Gallini, 1990; Moreno and Mayer, in press, all cited in Clark and Mayer, 2003), Mayer and collaborators compared the performance of students who learned from animation and narration vs. narration alone or from text and illustrations vs. text alone. In all ten comparisons, learners receiving the multimedia lesson performed significantly better on a subsequent transfer test than those who received the same information only in words. Mayer explained the evidence behind what has become his multimedia principle by stating that this dual display causes learners to mentally make connections between pictorial and verbal representations, resulting in deeper understanding than with words alone. Additionally, along with its ability to encourage active learning, media can also be used to facilitate intellectual development through providing otherwise unavailable learning experiences.

The Representational Features of Media and Multimedia. The ability of media to represent real objects is an important function. Media allow designers to communicate about objects, representations, and ideas about reality that would not otherwise be possible. The representational features of media are useful when communicating about:

- A procedure that is too risky to undergo in class
- An object that is not easily accessible (such as a planet, a foreign artifact, a rare song, or microscopic organism)
- A process too lengthy to accomplish in a semester's time
- A subject about which it is too hard to do the necessary experimentation to obtain needed evidence (Djikstra, Jonassen, & Sembill, 2001).

With the use of media, the designer can create a learning environment enabling the student to actively consult a constructed reality and potentially operate upon it (Djikstra, 2001).

Media and Schemata. Media are also educationally useful because through their use educators can affect their students' *schemata*. Schemata are mental constructs used to identify, process and store incoming information. According to Jean Piaget (as cited in Smaldino, Russell, Heinich, & Molenda, 2005), individuals organize their perceptions of their environment through schemata. As learning occurs, these constructs are modified through *assimilation* and *accommodation*. Assimilation is a process by which a learner integrates new information and experiences into his or her existing schemata. With *accommodation*, new experiences may result in changed or even new schemata. Experiences that result in intellectual development manifest in new or enlarged schema. Such experiences may occur in the course of everyday living, but cannot be counted upon to occur at educationally opportune moments. Through the use of media, educators can deliberately provide educationally expanding experiences to support teaching goals.

Media Attribute Theory. A number of researchers emphasized the importance of dealing with media as types, that is, for the attributes they provide and the learning strategies that they can implement (Smith & Ragan, 1999). A *media attribute* is the potential of a given medium to present information of a certain kind. It can facilitate learning for specific outcomes and certain kinds of learners. For example, to present a song, a medium that provides the ability to play a song is necessary. Audio is the logical medium to accomplish such a function.

Researchers have also investigated how the attributes of a medium can support the individual cognitive processes needed for specific learning tasks (Smith & Ragan, 1999). Some basic tenets of Salomon's Media Attribute Theory (1981) were that:

- Symbols are used both by media and by the human mind to represent, store and manipulate information
- Some of the symbol systems used by cognition are derived from the symbol systems that media use

Salomon (1981) defined *media* as modes of expression and communication, based on technologies, that result in new symbol systems or new blends of symbol systems. Symbol systems are sets of elements (such as words and pictures) that are interrelated within each system by syntax and used in specific ways (Kozma, 2001b). For example, within a text, words and sentences can represent people, objects and activities and be structured to form a story. A medium can be defined by its ability to use certain symbol systems (for example, while television can be thought of as a medium capable of representational (visual) and audio-linguistic symbols, radio can only display a subset of these, audio-linguistic symbols). Kozma (2001b) stated that studies illustrated how the symbol systems characteristic of certain media can connect mental representations to the real world in a way that learners with little prior knowledge have trouble doing on their own. Kozma contended that learners will benefit most from the use of a particular medium with certain capabilities if these capabilities are utilized by the instructional method to provide needed representations or cognitive operations of which the learner is incapable. Salomon proposed that one symbol system, when compared with another, can present information in better correspondence to – or congruity with – the mode of internal representation that an individual with a given cognitive makeup and task can best utilize. The closer the symbol systems of a particular medium are to the mental representations and skills needed for a given instructional task, the easier it will be for the learner to integrate it.

Instructional design theorists have historically been interested in the functions that media can provide for learning. It is important to emphasize that it is the *potential* that they identified as all implementations of a given media type will not necessarily produce the desired result (Criticos, 1996; Russell & Molenda, 1996). As an example, actors may be thought of as media elements of theater, film, and television. Directors (or casting directors) undergo an intensive casting process to find the actors that can convey exactly the qualities that are intended in a script in order to implement it properly in performance. In the same way that all actors of a given age and gender are not capable of equally conveying the qualities intended by a screenwriter, and upon which the significance of a script can hinge, all implementations of a given media element may not produce needed functionality.

The Instructional Attributes of Selected Media Types

The instructional attributes of media should be at the heart of media selection (Reiser & Gagne, 1983). Media attributes are the affordances that different media provide to clearly deliver various kinds of instructional messages and to verify that learners have learned that content (Romiszowski. 1988). Media attributes should be thought of functionally (Romiszoski), that is, whether they are capable of providing the kind of stimuli necessary to communicate a specific kind of message clearly and if they can accommodate student responses. For example, visuals can provide a more concrete referent for words, helping to avoid misunderstandings. Motion media and sequential stills can be used to display a process. Media can also be used for evaluation; students can be asked to identify objects in photographs, listen to a symphony in audio and identify the movements, or describe how they would respond to a situation depicted in a video.

A number of theorists including Clark (1999); Reynolds and Anderson (1992); Romiszowski, (1988); Reiser and Gagne (1983) and Smaldino, Russell, Heinich, and Molenda, (2005) have identified advantages, limitations and suggested applications of various educational media. While work remains to scientifically validate the instructional attributes of various media and multimedia, a body of knowledge along these lines does exist (Cohen, 2004).

Samaras et al. (2004) defined a classification scheme for multimedia research which can also be applied to research about media and multimedia attributes. The authors categorized media and multimedia research into three categories that they defined as first, second, and third generation research.

- First generation research originated prior to the 1990s, before computers and multimedia systems began to be commonly used for educational purposes. In general, this research related to how learners integrate and capitalize on information presented to them verbally and visually. Many of these studies were conducted in fields outside of education including art, motion pictures, advertising and psychology. The results of these studies gradually passed over to education and had a significant influence on educational multimedia research, design, and theory and in particular instructional design (Samaras et al.).

- Second generation research is research related to how verbal and visual information should be arranged and presented to facilitate learning and to overcome the limitations of human working memory. These empirical studies have yielded significant instructional design theories, guidelines and models. Work of this sort that applied to the instructional attributes of media included that of Richard Mayer, John Sweller and associates (Chandler & Sweller, 1985; Clark & Mayer, 2003; Mautone & Mayer, 2001; Mayer, 1999; Mayer, 2001; Mayer, Sobko, & Mautone, 2003; Mousavi, Low & Sweller, 1995; Sweller & Cooper, 1985).
- Third generation research is research being conducted currently that is trying to characterize the role that different media can play in learning. This research encompasses a number of different directions including learning styles and limits set by prior knowledge. Empirical research on the attributes of different media is one direction of this contemporary third-generation research (Reimann, 2003; Rouet, Levonen, & Biardeau, 2001). These studies tended to focus upon the most effective ways of presenting media and multimedia, extending second generation research in its focus on specific methods for implementation.

There is a large body of first generation research about the instructional attributes of media of questionable scientific validity as well as the far more limited empirical second generation research and the emerging research being conducted today. References to these first generation studies can be found in several instructional technology books that deal with media selection (Clark, 1999; Reynolds & Anderson, 1992; Romiszowski, 1988; Reiser & Gagne, 1983; and Smaldino, Russell, Heinich,& Molenda, 2005) and in a dissertation by Seels (1971). The scientific rigor behind the reported media attribute findings is hard to determine. For the most part, the authors did not identify the research sources for the conclusions that they drew related to media attributes. It can be assumed that most of the conclusions related to the instructional attributes of media were probably theoretical rather than proven experimentally. Most of the theorists seemed to assume that the features of media attributes are evident from simple observation, therefore precluding the need for experimental verification; for example, it is obvious that audio media is conducive to applications requiring hearing and that visual media make it possible to see (Reiser & Gagne, 1983; Romiszowski, 1988).

However, there may be additional reasons why the authors didn't tend to provide sources for the reported findings. With the exception of Seels (1971), Romiszowski (1988), and Reiser and Gagne (1983), these authors did not seem to see themselves as writing primarily for other researchers but rather providing proscriptions for practitioners: "the people in the trenches" (Reynolds and Anderson, 1992, p. xvii). So while their bibliographies and "Suggested Readings" provided evidence that these works were clearly cognizant of and based in research, the findings that they reported were not identified by research source.

Furthermore, the field of instructional design and technology like other educational fields has not tended to employ rigorous scientific methodology for studies, and so the studies that were reported were not analyzed by these authors on that basis. The books that were written for researchers as well as practitioners, particularly Romiszowski (1988) and Reiser and Gagne (1983), did identify a few studies upon which some of the identified attributes were based. They didn't however provide details of the studies' experimental features or discussion of their methodological validity.

There may also have been a lack of clarity within the instructional design field about the extent to which media attributes needed to be verified through research. Reiser and Gagne (1983) appear to have displayed some ambivalence about the issue. On the one hand, they stated that the conditions necessary for learning specific types of information were established through research and that to take the next step of making media proscriptions, it would be necessary to analyze which types of media were capable of providing those conditions on the basis of their attributes (without a mention of this analysis being based upon research findings). Then on the other hand they did pose as an unresolved research question whether they have identified the correct media to fulfill various learning outcomes, indicating that these issues were not answered to their satisfaction at the time they completed their study. These instructional attributes provide a foundation upon which to make media selection decisions (Romiszowski, 1988). The question of whether – and to what extent – media attributes need to be validated through research remains today.

Thinking about media in terms of how their functions contribute to teaching and learning, or their instructional attributes, makes it possible to select online resources that will result in maximum learning effectiveness. The first step in doing so is to specify a learning outcome for what one is seeking to teach and then to identify the learning outcome category to which that learning outcome belongs (Reiser & Gagne, 1983).

According to a number of instructional design theorists, different media excel at teaching different learning outcome category types. Gagne and Briggs as cited in Reiser and Gagne (1983) identified the following learning outcome categories:

- *Intellectual* skills that enable individuals to understand symbols and conceptualizations and act upon them. Such skills include procedural knowledge that enables someone *to do something* of an intellectual nature. In the early grades this relates to the mastery of basic skills; later it relates to demonstrating mastery of skills connected to more advanced topics. Such learning contrasts with verbal information in which one learns that something exists or has certain properties.
- *Verbal* information is the kind of knowledge that learners can state – declarative knowledge.
- *Cognitive* strategies are capabilities that enable the individuals to learn and solve instructional problems effectively.
- *Motor* skills are skills that utilize motor capabilities such as printing letters, riding a bicycle, or opening a combination lock.
- *Attitudes* are learned affective states that affect a learner's choice of personal action.

Based upon some of this first, second and third generation research, descriptions of the instructional attributes, and in many cases the learning outcome categories for which they can best be used, of the following media follow.

- Text
- Audio

- Moving image (video)
- Animation
- Flat, still pictures

Text. Online resources often contain text. Romiszowski (1988) cited works by Hartley and Jonassen that summarized early research about text. Reiser and Gagne (1983) found text to be the most efficient medium for conveying verbal information to good readers. Concepts and rules (intellectual skills) may also be readily learned from printed text; however, with intellectual skills, providing opportunities for practice and feedback is necessary (Reiser & Gagne, 1983).

William Allen developed an early media selection model in 1967 (Allen's Media Selection Model) based on a review of hundreds of research studies (as cited in Romiszowki, 1988). After discarding the studies that did not meet his research criteria, Allen created a matrix which classified media according to high, medium and low ability to deliver specific types of learning objectives. Allen's Media Selection Model found text to be effective at teaching content in the Attitude learning outcome category. Reynolds and Anderson (1992) stated that this was not true as a rule, but found that some particular examples of printed materials could be very interesting and could stir the emotions, thereby being effective at reaching affective objectives.

Clark and Mayer (2003) stated that for memory support, e-Learning information that must be memorized should be presented as text that remains for a while on the screen rather than audio that is transitory.

Audio Media. Audio can record and transmit the human voice and other sounds for educational purposes. Romiszowski (1988) cited several studies that found that audio has many advantages for learners who do not read or do not read well. Audio can deliver instruction allowing the learners' hands to remain free to implement suggested activities. Audio media can deliver verbal information in a more compelling way than can text. It can also be used for stories, poems and music as well as oral histories. Students can record themselves for evaluation by the instructor. Students with poor reading skills benefit enormously from audio-delivered instruction. The downside of audio is that some students find it hard to attend to and/or understand instruction delivered via audio. Audio tends to fix the sequence of a presentation, but it can usually be replayed as necessary (Russell & Molenda, 1996). Smaldino, Russell, Heinich, and Molenda (2005) stated that this aspect of repeatability is one of audio's most useful functions, making self paced instruction possible. Thus it is important when placing audio on the web to make sure that the student can replay it and to replay it at reasonable intervals.

Reiser and Gagne (1983) wrote that audio is a good medium though which to teach verbal information. They stated that it could guide the learning of intellectual and motor skills. Making use of the voice of a recognizable and admired role model is an effective way to establish attitudes. The authors suggested that introducing problems through dramatic audio segments would probably also be effective. Reynolds and Anderson (1992) wrote that audio was useful in the cognitive domain to teach recognition and discrimination of relevant audio stimuli such as music. For psychomotor learning they found it can be used to teach verbal and musical skills, making it possible for students to hear, imitate, and practice such skills. In the attitude domain they found that the use of background music, sound effects and narrator's voices can result in affective outcomes.

A number of researchers stated that audio combined with other media rather than by itself is most effective for many educational purposes. Clark (1999) wrote that audio provides considerable cognitive advantage over visuals alone. Such audio is most effective when the information it is providing is different but complementary, rather than the same, as the information being provided by the visual elements. Reynolds and Anderson (1992) stated that supplementation by printed matter and still visuals make audio most effective for teaching rules and principles. Reiser and Gagne (1983) wrote that supplementing audio with printed materials enabling student response and corrective feedback makes audio most effective at teaching intellectual skills.

Video. Video is especially effective for portraying procedures (Smaldino, Russell, Heinich, & Molenda, 2005). Video can promote cultural understanding through depicting other ways of life. Romiszowski (1988) cited several studies finding that the moving image arts including film and video are effective at changing attitudes. The moving image arts can display physical skills, enabling mastery and emulation through repeated viewing. They can bring topics to life through dramatic recreations. Because of the emotional impact they can engender, film and video are suitable for shaping attitudes, particularly though showing choices made by human models (Reiser & Gagne, 1983). Open-ended dramatizations can lead to stimulating discussion. They can be used to display phenomena that would be dangerous to view directly. Video allows for manipulation of space (seeing things from different points of view) and time (through the use of time lapse) (Russell & Molenda, 1996).

Reynolds and Anderson (1992) wrote that video is good for learning outcomes falling into the *cognitive skills category*, because it is effective at teaching recognition and discrimination of relevant motion stimuli. It can also be used to teach rules and principles and model performance, especially in situations requiring human interaction. Video can be useful in modeling motion skills in the *psychomotor* learning outcomes area; motion can be exaggerated fast or slow to aid understanding. Reynolds and Anderson stated that video is most useful in the *affective* learning outcomes area for creating attitudes and emotion through various techniques. Reiser and Gagne (1983) wrote that video is good for *intellectual* and *motor skills* when combined with print requiring learner response.

Bickford (1997) wrote that video is good for storytelling and for capturing the real world. Clark (1999) wrote that video is useful for presenting case studies. In introducing case studies, the video often takes the form of a "talking head", usually placed in the center of the computer screen. She found that it is important to use a consistent placement on the computer screen for video. Clark also found that video can be effectively (and economically) replaced online with still photos, line drawings with arrows and simple animations supported by audio. Because of the current technical difficulties in presenting video flawlessly on many computer systems, in addition to the small size at which video displays when part of an online course, online resources consisting of or containing video should be assessed individually to ensure that they meet the potentials of the video medium described here.

Animation. Animation is a medium in which motion has been given to an otherwise inanimate object. Animation makes it possible to manipulate time and space and to simplify complex and rapid processes (Smaldino, Russell, Heinich, & Molenda, 2005). Bickford (1997) wrote that animation excels at communicating the abstract and the conceptual, for communicating meaning without getting lost in detail, in contrast with video that excels at capturing the real world.

When communicating detail, managing cognitive load becomes very important with the use of animation. Moreno and Mayer (2002) found that animation preceding a redundant or non-redundant verbal explanation helps students to remember more, generate more creative solutions on a transfer test and correctly match more items. But presenting animations simultaneously with redundant explanations caused students to perform more poorly. These findings were based on three experiments by the authors in which they focused on two questions:

- Does the addition of on-screen text to an understandable auditory narration enhance comprehension of a complex scientific system?
- How is the processing of verbal information affected by the presentation of additional nonverbal information such as graphics?

To answer the first question, the authors compared the learning results of students presented with an auditory explanation of scientific phenomenon with those of students presented with the same explanation plus on-screen text. The authors examined the results of adding a sequential or simultaneous animation to answer the second question.

As a result of the three experiments, the authors found that:

- Adding redundant verbal on-screen information to an auditory narration *when dynamic graphics are not concurrently presented* helps students to remember more, generate more creative solutions on a transfer test and correctly match more items.
- Adding an animation *preceding the redundant or non-redundant explanation* also helps students to remember more, generate more creative solutions on a transfer test and correctly match more items.
- But presenting dynamic graphics or animations *simultaneously with redundant explanations* caused students to perform more poorly.

The authors hypothesized that this is due to cognitive overload and is consistent with the dual processing theory of multimedia learning.

Clark (1999) wrote that animated color diagrams supplemented by text can be used to describe processes telling how something works. Lowe (2001) stated that for an animated application, a careful treatment is necessary; animation with too many details can be hard for students to process due to information overload. Lowe did an experiment with 24 beginning students of environmental science in which they studied animated weather maps in pairs. On the basis of what they learned from interacting with the animated weather maps, they were given the task of compiling individual sets of records that could help them to generate better predictions from a given static weather map. The animations they studied provided user affordances including user control of the animation, interaction with the display at a number of levels, and visual cueing of significant features of the pattern. The records that the students generated indicated that they were most successful in detecting gross changes in the pattern of meteorological markings, but what was almost completely missing were details of smaller scale yet meteorogically significant changes. Subjects were also comparatively unsuccessful in knowing where to look, how to look, what to notice and how to link different units of information with one another despite the use of various multimedia techniques to emphasize important information. The researcher concluded that the task of helping novices within a given subject area to develop mental representations from diagrams is particularly difficult. He hypothesized that developing several independent alternative treatments of the same sequence of animated frames , each dealing with a different level of the same informational hierarchy, might be a solution.

Clark suggested that the following treatment can be effective in helping learners to manage cognitive load while learning process detail: an animated graphic providing a process overview at the top might be supplemented by a scrollable text frame at the bottom of a screen to which various process stages are cued with arrows. By clicking an arrow and selecting a zoom button, a detailed visual with text describing that stage might appear.

Clark (1999) stated that animation supplemented by audio can effectively replace video. She cautioned against the use of blinking content, a type of animation, as an impediment to learning.

Visuals. Summarizing the research about visuals presents some difficulty because there are a number of different kinds of visuals that serve different instructional purposes. Researchers have not always distinguished between the instructional attributes of different types of visuals. There has not been a consensus among the researchers of a classification system for visuals (Clark, 1999; Smaldino, Russell, Heinich, & Molenda, 2005; Reiser & Gagne, 1983; Reynolds & Anderson, 1992; and Romiszowki, 1988) and there has been some inconsistency in names and definitions of the visuals types.

Some of the classifications systems that have been suggested will be presented next. Romiszowski (1988) divided visual display materials into three types:

- Pictures, including visuals aiming at true and life like representations of real objects including photos, line drawings, and paintings
- Diagrams, including visuals aiming at a clear depiction of an object or specific characteristics of an object. Examples of diagrams include cross sections, schematics, engineering drawings and flow diagrams.
- Graphic presentations that aim to present a trend, interrelationship or a set of figures. These include graphs and charts and can depict processes, concepts or a phenomenon.

Smaldino, Russell, Heinich, and Molenda (2005) added several categories to make distinctions between the following visuals on the basis of instructional attributes:

- Drawings, which can be easier to learn from than *photos* because they can be less detailed
- Graphs, which provide a visual representation of numerical data, unlike *charts*, which are visual representations of abstract concepts such as organizational charts, time lines, and flowcharts.

Clark (2003) developed a communication taxonomy for graphics for learning, which grouped graphics by their functional capacities for computer-based education.

Her categories included:

- Decorative, for aesthetic appeal or humor, such as art on a book cover – should be used minimally for learning applications
- Representational – Depicts an object in a realistic fashion, such as a screen capture or photograph of equipment
- Mnenemonic – Provides retrieval cues for factual information
- Organizational – Shows qualitative relationships among content, such as a course map
- Relational – Shows quantitative relationships, such as a line graph or pie chart
- Transformational – Shows changes in objects over time or space, such as an animation of a weather cycle or video of a mechanical process
- Interpretive – To illustrate a theory or principle such as an animation of molecular movement

On the basis of instructional attributes, the classifications systems of Romiszowski (1988) and Smaldino, Russell, Heinich and Molenda (2005) are combined here to result in the following visuals classification system:

- Photographs
- Drawings
- Diagrams
- Graphics (including charts and graphs)

Photographs. Russell and Molenda (1996) wrote that this category of media can be used to transform abstract ideas into a realistic format. Readily available, these images can be scanned into a computer. They can be used to illustrate certain content areas that will benefit from visual amplification. Photographs can be helpful in the study of processes. In social studies, they can depict realities to make them more understandable. They can be used to stimulate creative expression. They are also useful for testing and are helpful in achieving outcomes in which identification of people, places or things is necessary.

Reiser and Gagne (1983) stated that photos are useful to present the distinctive features of visual phenomena. They wrote that photos could be useful with outcomes in the verbal information category to illustrate concepts, thereby aiding in retention. They stated that attitude learning outcomes could be achieved through photos of people. They wrote that the absence of motion and sound could be a hindrance, making video (or visuals in a sequence integrated with sound) to be more effective. Reynolds and Anderson (1992) stated that cognitive learning outcomes could be accomplished with photos by pointing out critical differences between objects as well as exaggerating differences that might otherwise be overlooked.

Photos can also be used to present a multi-image presentation online, using two or more photos simultaneously (Smaldino, Russell, Heinich & Molenda, 2005). For example, two or more photos can be used to show a “before” and “after”, to compare and contrast art work or other visual phenomena or to present an overview or wide shot of a visual while the other(s) show a close up or detail view. Or a photo of an area can be contrasted with a map of the same location.

Drawings. Clark (1999) stated that drawings can display many of the same representational qualities as photos and, in many cases, drawings provide the same or similar instructional attributes as photographs. A drawing obviously can’t provide the same true-to-life representation as a photo. But the fact that a drawing's detail can be more or less pronounced can make it more useful than a photo. Clark wrote that concrete facts such as forms, computer screens and equipment are better expressed through simple line diagrams than photos because due to extraneous details, the photo can provide too much cognitive load. When more detail is needed, callouts or a linked table can be used with a simpler drawing.

A drawing can display information that is not visible to the eye and thus cannot be displayed through a photograph. Reynolds and Anderson (1992) wrote that certain cognitive learning outcomes can be achieved through displaying the principles of operation of objects that normally have their working parts enclosed. The authors also state that other cognitive outcomes can be achieved through showing critical differences among objects and exaggerating differences in objects that might otherwise be overlooked.

Researchers disagreed about the effectiveness of photos and drawings for psychomotor learning outcomes. Anderson and Reynolds (1992) wrote that the usefulness of the media of drawings and photos is limited to showing the positions of people or things in motion, and thus is low in applicability. The Allen Media Selection Model (as cited in Romiszowki, 1988) stated that illustrations in text are low in achieving skilled perceptual motor arts. However, Durham, Gerheart and Austin (as cited in Romiszowki, 1988) wrote that photos and drawings can be effective at facilitating psychomotor learning outcomes.

When supplemented by text, drawings and photos have greater capabilities. They can be sequenced to teach principles or steps in psychomotor skills and to show positions of objects in motion and/or when being manipulated (Anderson & Reynolds, 1992). They can achieve cognitive learning outcomes through providing factual information, presenting vocabulary, providing directions, and describing work flow.

When supplemented by audio, sequentially presented drawings and photos can be used for the same purposes as video but for much less cost (Clark, 1999; Smaldino, Russell, Heinich, & Molenda, 2005). The capabilities of such visuals may be somewhat diminished in that they don't move, can't provide as many distinctive cues, can't elaborate verbal information as well, nor can they display the same degree of realism (Reiser & Gagne, 1983). However, they are capable of elaborating verbal information, resulting in verbal outcomes, they can present human models and their actions for attitude outcomes, and they can provide cues to distinguish visual tasks for cognitive outcomes. Durham et al. (as cited in Romiszowki, 1988) wrote that such materials were excellent for achieving psychomotor outcomes. Clark (1999) stated that when audio is used to supplement visuals, the audio should be kept short and should be designed to complement the visual elements of the screen.

Diagrams. Diagrams are visuals aiming at a clear depiction of an object or specific characteristics of an object such as cross sections, schematics, engineering drawings and flow diagrams (Romiszowki, 1988). Reiser and Gagne(1983) wrote that diagrams are well adapted to helping learners achieve intellectual outcomes, particularly concepts and rules, because they can give emphasis to distinctive visual elements and provide analogies to clarify the relationships among topics being taught. They can convey the meanings of more abstract meanings and rules through illustrating the relationship among concepts. For such learning to be effective, students have to be provided with a way to demonstrate and get feedback on what they have learned.

Reynolds and Anderson (1992) stated that diagrams could be used effectively to reinforce print or audio narrative to teach intellectual outcomes including rules, principles, and concepts. An appropriate diagram can be used as part of a multi-image visual presentation, for example, to show a schematic of components next to the actual components (Smaldino, Russell, Heinich, & Molenda, 2005). Such a visual could result in intellectual or verbal learning outcomes.

Graphics. The category of graphics consists of graphs and charts. *Graphs* provide a visual representation of numerical data while *charts* are visual representations of abstract concepts such as organizational charts, time lines, and flowcharts. The purpose of both graphs and charts is to depict processes, concepts, phenomena, trends, interrelationships or a set of figures (Romiszowski, 1988). These correspond primarily to intellectual and verbal learning outcomes. Reiser and Gagne (1983) wrote that such visuals were effective at achieving intellectual learning outcomes such as concepts and rules, particularly if supplemented by opportunities for students to demonstrate and receive feedback on what they have learned. Reynolds and Anderson (1988) concurred that such visuals can be used to teach rules, principles, and concepts. Such visuals can be especially effective when supplementing written or audio narrative. When combined with applicable audio, such materials can effectively achieve learning outcomes in the attitude area.

Summary of the Instructional Attributes of Media Types. The instructional attributes of these educational media, although for the most part established prior to online courses, in general do apply to their use when they are adapted for computer applications (Cohen, 2004).

Analyzing how the attributes of media enable various instructional strategies makes it possible to design instruction – including selecting online resources - for maximum educational effectiveness. The analysis of media attributes has been one of the focuses of media selection.

Media Selection and Media Selection Models

In the earliest stages of the instructional design process, the focus is on *what* to teach; with the media selection phase, the focus changes to *how* to teach (Briggs & Wager, 1981). Media selection is an important stage in the instructional design process and historically has been one of the principal research focuses of the field of instructional design. The roots of instructional design are audiovisual education and instructional psychology (Richey & Nelson, 1996), and initially media practitioners tended to work with their favorite media. Over the years, however, two approaches to media selection have evolved: the intuitive approach generally used by classroom teachers and the systematic approach often used by instructional designers (Criticos, 1996).

The idea that has driven the systematic approach is that selecting media systematically results in optimally effective instruction (Reiser & Gagne, 1983). Over the years, a number of *media selection models* have been developed to guide the systematic approach. A systematic approach to media selection involves analysis of instructional task criteria such as behavioral objectives, performance objectives, learning outcomes, and instructional strategies. Once an instructional strategy has been determined, the choice of media element can be made.

Prior to the advent of e-learning, a number of media selection models were developed by instructional design theoreticians and researchers. They shared a vision of media selection as an important stage of the instructional design process. Media selection models were developed because of a common recognition of a need for guidance for novices to make successful media selection decisions systematically. Media selection models served as performance support tools, their purpose to make available the scaffolding necessary to aid those unfamiliar in the media selection process. Like a number of other instructional design models, many media selection models lacked a sound empirical foundation (Gustafson & Branch, 2002a; Reiser & Gagne, 1983). Reiser and Gagne stated that few media selection models were actually tested for effectiveness. Additionally, after developing and testing an effective media selection model, Reiser and Gagne stated that the following research questions remained to be resolved:

- Does the model identify the most appropriate media to use in a given instructional situation?
- Have the correct conditions of learning been identified?
- Have the correct media capable of satisfying those conditions been identified?
- Is the scope of instruction for which media are chosen of appropriate size?
- Does the model account for all of the important variables affecting learning effectiveness?

Some media selection models have been tested and found effective (Reiser & Gagne, 1983; Romiszowski, 1988). For example, Romiszowski compared the media selection achievement of 52 experienced teachers without his media selection job aids but utilizing an intuitive approach with that of 58 inexperienced trainee teachers with job aids. Subjects were asked to prepare a lesson plan for four given learning objectives using any media that they thought were appropriate. These lesson plans were then judged by a team of educational technologists and experts in teaching methods who judged the treatment of each of the objectives as ideal, acceptable or poor. The inexperienced teachers using the job aids did significantly better at the task than the experienced teachers without the job aids.

Another study of the effectiveness of media selection models was conducted by Braby (as cited in Reiser and Gagne, 1983) who compared the usefulness of ten media selection techniques and found that the models developed by Briggs and the Training Analysis and Evaluation Group worked better than the other eight models in the study. In the Braby study, six instructional designers were asked to learn and apply ten media selection techniques. Each designer applied all of the techniques to seven training tasks, making approximately 70 media selection decisions. Each of these choices was then rated by two media selection experts. Ratings for all choices made with each technique were then summed and compared. Also compared was the time it took for the designers to learn and apply each technique as well as the designers' assessment of each technique's usefulness.

The Reiser and Gagne Media selection model (as cited in Reiser and Gagne, 1983) was prepared for the U.S. Army and was evaluated through four cycles of review and revision. In the first formative evaluation, instructional designers who were not associated with the model's development reviewed the model and provided suggestions.

These suggestions were incorporated when appropriate, and then a formal procedure was devised to evaluate the model in the next three cycles. The purpose of this evaluation was to determine how successfully an instructional designer who had not previously seen the model could use it to select the appropriate media for a variety of instructional situations. Different groups of individuals including graduate students and army instructional designers participated in these evaluation cycles. Individual subjects would work with a model developer. They were given copies of the media selection flowcharts and the instructions preceding it. Then they were given a written description of how the model would be used in particular situations. During this process subjects were encouraged to make comments and ask questions. After reviewing these materials, each subject was given a list describing six instructional situations and was asked to use the media selection flowchart to identify the appropriate media for each case. Each situation was devised so that a maximum of two correct paths could be taken through the flowcharts. Deviations from the correct paths were recorded to reveal possible flowchart flaws. After working through the situations, subjects in the third and fourth cycles were asked to complete an attitude questionnaire pertaining to the model. The model was revised after each cycle. After the fourth cycle, few changes were made because the subjects were able to easily use the model. The attitude data collected through the questionnaires revealed that the participating subjects had very positive attitudes toward the usefulness and ease of use of the model although only 6 of the 11 designers thought it was probable that the model would be used on the job, probably because of administrative restrictions limiting the use of media selection procedures..

Such administrative restrictions are unlikely with the great need for guidance in developing online instruction today. With the bewildering options presented by today's electronic media, the necessity for understanding media selection and the factors influencing selections – and providing performance support to do so – is even more critical than previously (Criticos, 1996). Yesterday's media selection models were based on numerous instructional design concerns and decisions that are applicable today; additional modifications are necessary to reflect an evolving environment that is online and holds the potential for the delivery of multimedia.

Additionally, instructional materials carry much more weight in today's e-learning context, making the task of media selection more critical. An important distinction to consider when selecting media is whether the purpose of the instructional materials is to supplement a teacher's instruction or to deliver standalone instruction (Kemp, 1980). Yesterday's models were often designed for a climate in which media were usually supplements to instruction. With many of today's online courses, the instructional materials carry the entire burden of the instructional communication. Furthermore, with online learning, decisions regarding which media element(s) to use must be made numerous times for a single course (Kozma, 2001a).

This section will focus upon three types of media selection models, referred to here as *Quick Reference Media Selection Models*, *Inclusive Media Selection Models*, and *Procedures for Media Selection*.

A Quick-Reference Media Selection Model is a performance support tool that makes it possible to come to a media selection decision in a relatively short time. An Inclusive Media Selection Model is a more complex performance support tool that provides a reference function. Procedures for Media Selection lack the guidance to actually lead the user through the Media Selection process. However, the procedures discussed here offer much of value in enabling users to arrive at good media selection decisions.

The following important factors of media selection are addressed to varying degrees by the media selection models (Gagne, Briggs & Wager, 1992):

- The media types included for consideration
- Physical attributes of media – the physical aspects of communication that the media are able to display, for example visual displays make it possible to teach concrete concepts, such as shapes and objects and spatial relationships such as locations and distances. Some models merely specify "visual display" and others make finer distinctions such as "photos" and "graphics". The physical attributes of multimedia can further be defined by the technology that they employ. For example, the limiting size and resolution of some computer screens makes them harder to read from than a book, presenting obstacles to learning. The processing abilities that can operate on available symbol systems are also a factor (for example, information can be searched on a videodisc in a way not possible with broadcast video). Media selection models include these physical media attributes to a greater and lesser extent.
- Instructional attributes of media – how the media supports the type of performance expected of learners as a result of the instruction. Media differ in their ability to support various types of expected performance. For example, when concepts involving spatial relationships are being learned, pictures are a much more effective medium than verbal descriptions. Depending upon the

type of spatial relationship, the use of one kind of picture, such as a photograph, may be much more effective than another. Intellectual skill learning requires a medium that can present multiple examples, question the learner about the examples, and provide feedback about the accuracy of the learner's response. Print-based computer training and interactive multimedia would both be capable of fulfilling these requirements. Models vary not only in the instructional attributes that they include but also to the extent that they guide users in making these determinations (Criticos, 1996).

- The learning outcome system utilized to classify the learning task - many models use a classification system based on that proposed by Gagne (Gagne, Briggs, & Wager, 1992), but not all do. Gagne's learning outcome classification system includes Intellectual Skills, Cognitive Strategies, Verbal Information, Motor Skills, and Attitude. The classification of learning outcome types is important for media selection because individual learning outcome task types tend to be best taught through specific instructional strategies (Smith & Ragan, 1999). Such instructional strategies are most effectively communicated through the use of particular media and combinations of media (Clark, 1999).
- Learner variables – Media selection models consider learner variables to varying degrees. Learner variables include such factors as ability to read and age of the learner.

- Various environmental factors including practical matters such as budget and the availability of resources associated with the learning environment and the development environment. Cultural considerations may also be a factor.

Other important factors related to media selection models (Reiser & Gagne, 1983) include:

- Whether the model has been tested and the protocols used
- At what level of granularity (such as learning objective or event of instruction) the selection model is to be applied
- The display format of the model
- The usability of the model, including the clarity of verbal descriptors and the effectiveness of the guidance or scaffolding (Shneiderman, 1998)

Quick Reference Media Selection Models

This section discusses the Reiser Gagne Media Selection Model (1983) and the Kemp Media Selection Model (1980). Both are examples of Quick Reference Media Selection Models which make quick media selection decisions possible.

The most prominent of the Media Selection Models is the Reiser Gagne model (1983). This well tested model was cited as an example of media selection models in a number of contemporary instructional design textbooks (Dick, Carey & Carey, 2000; Smith & Ragan, 1999). The notable features of the model included a very usable format combining flowchart and matrix worksheet, very clear verbal descriptors with definitions provided as well, and the necessary performance support for a user to easily navigate through the model (Romiszowski, 1988).

This well designed model has an organizational structure consisting of a series of comprehensive flowcharts. The flowcharts lead the user through a series of questions, resulting in a short list of suggested media. The model requires tasks prior to and following use of the flowcharts. Each of the six pages of flowcharts has a separate question on the top. The question heading each of the flowcharts is related to the instructional context followed by more questions if the answer to the first question is affirmative. Thus there is one page for each context, and within that context questions are asked to determine the category of learning outcome. On that basis, candidate media are suggested. The flowchart form makes use easy for those with minimal experience. The model also provides a matrix worksheet on which to record the learning objective and related media decision.

The Reiser Gagne model, like that of several others, suggests a procedure consisting of the following tasks:

- Categorize learning outcomes
- Plan instructional events to use to teach each learning outcome
- Identify types of stimuli necessary to present events
- Identify media capable of presenting stimuli

Reiser and Gagne suggested that users choose their own desired granularity for their media selection decisions. However, they do recommend that the decision be at the level of the learning objective.

Smaldino, Russell, Heinich, and Molenda (2005) stated that with models such as Reiser Gagne's that are Quick Reference, there is often a tradeoff between simplicity and comprehensiveness. Simplicity is a great strength of the Reiser Gagne model; its many rounds of formative testing are evident in its usability. However, the model provides a limited number of media from which to choose and comparatively little detail about the physical and instructional attributes of media. Were these factors not abbreviated, all the elements related to one instructional context couldn't fit onto one page. The importance of these omissions is hard to determine. Among the research questions to be explored in the future, Reiser and Gagne (1983) suggested asking whether they have correctly identified the conditions of learning that should be established and whether they have correctly identified the media capable of providing those conditions of learning.

The Kemp Media Selection Model (1980) consists of three charts classified by the instructional context: self-paced study for individual students, small group interaction, and presentation to a regular-size class or large group. Unlike the Reiser Gagne model, the Kemp model does not consider the learning outcome type of the task or the instructional attributes that media can provide. In place of learning outcomes, this model asks the designer to consider whether what is needed are (1) verbal abstractions, (2) direct concrete experience, or (3) vicarious or sensory experience. Novices may find it difficult to make this determination without support and/or further definitions. However, the idea behind this approach is intriguing in that it could potentially enable the user to make quick decisions about how to treat much of the material without having to consider each learning objective. This model also includes many media types and physical attributes of media; for example, within graphics it lists diagrams, charts, pictures, cartoons, and picture books. However, the model does not include the instructional attributes of media, and little guidance is provided enabling the user in deciding why to choose one media type rather than another.

Inclusive Media Selection Models

The two inclusive media selection models discussed here are the Romiszowski model (1988) and the Reynolds and Anderson model (1992). Much useful information is provided in both, but the complexity of the material makes the media selection process somewhat cumbersome. Both models include much detailed information about many media types as well as the physical and instructional attributes of media. Neither model purported to be a quick reference. Romiszowski saw his model as a handbook, Reynolds and Anderson a mini-textbook.

The Reynolds and Anderson model presents its information through multiple flowcharts that are keyed to one another to aid the user with navigation. The model makes a critical distinction between *instruction* designed to elicit a performance from the learner and *information* being disseminated. The model also distinguishes between materials to *supplement instruction* and those designed to *deliver all of the instruction*. No testing of the Reynolds Anderson model was reported.

The Romiszowki model divides media characteristics into two types: required (controlling the clarity of the instructional message) and optional (related to the quality of the media display). The model contains much valuable information including flowcharts about (1) decisions for matching learning tasks to media characteristics, (2) decisions for selecting visual media and (3) decisions for selecting verbal and sound media. The model presented in the book appears to lack the guidance that would enable users to easily navigate the process on their own. Positive findings from testing of the model were reported; however, the exact conditions of the testing were not included (Romiszowski, 1988).

Procedures for Media Selection

Two procedures for media selection are discussed here: The Briggs and Wager Procedure (1981) and the ASSURE Model by Smaldino, Russell, Heinich, and Molenda, (2005). The Briggs and Wager procedure is very thorough, including many considerations necessary for media selection. It recommends the critical concept of "size of chunk", making the recommendation that media selection be done for each lesson event based on Gagne's Events of Instruction (Gagne, 1992). It provides the Matrix of Utilization designed by Wilshusen and Stowe (as cited in Briggs and Wager, 1981) that analyzes a number of media in terms of the following elements: Learner Characteristics, Task Requirements, Materials, Transmission, and Events of Instruction. It also contains two useful worksheets: a Media Analysis Worksheet and a Timeline Sequence for Instructional Events. The Media Analysis Worksheet provides a way for course designers to track their media selection decisions; it has blank columns for Instructional Event, Stimuli, Media Alternatives, Tentative (Ideal) Media, Final Media Choices, Rationale and Prescription. The Timeline Sequence for Instructional Events makes it possible to calculate how long it will take to deliver a lesson based on the media selected on the Media Analysis Worksheet. The Timeline is keyed to the Media Analysis Worksheet.

The ASSURE Model is a procedure for planning and delivering instruction (Smaldino, Russell, Heinich, & Molenda, 2005). It is oriented toward classroom use (Gustafson & Branch, 2002a). The acronym ASSURE stands for the following: Analyze learners, State objectives, Select media and materials, Utilize materials, Require learner performance, Evaluate/Revise. ASSURE considers the learning outcome classification system an important element of media selection. The authors presented the Reiser Gagne media selection model (1983) as a sample media selection schema, but stated that the book's purpose is to help readers to devise their own media selection schemas. A very important feature of the model is that there are three alternative methods for obtaining the desired media: selecting available materials, modifying existing materials, or designing new materials. The authors made the important point that in the busy world of the classroom teacher, designing new materials is rarely an option. If existing materials are available that will meet a given need, it is advantageous in the classroom context to select them and modify if necessary.

Media Selection Models Conclusion

The previously discussed media selection models did not exist in a vacuum; the developers of these models were informed by the work of the others as well as related media selection theories. For a time, media selection was a strong focus of the Instructional Design and Technology field. While some of the models were tested and found to be effective (Reiser & Gagne, 1983; Romiszowki, 1988), many were not. These media selection models from the past, though largely lacking an empirical basis as instruments, provide a legacy for work on online resource selection to be done today. Their creators' thinking about how media help people learn was based on research (Reynolds & Anderson, 1992), and thus these products can provide a foundation for current study of online educational resource selection.

Multimedia

The combination of two or more of the previously discussed media elements comprise *multimedia*. Clark and Mayer (2003) defined a multimedia presentation as any presentation containing a combination of two or more media elements. With multimedia, the attributes found in media become multimedia attributes or, as identified by Jonassen (2001), multimedia presentation modes. Presentation modes are formats that represent ideas in multimedia. Jonassen's categories are text, still images, image manipulations, spatial positioning, interface, video, sounds, data structures, transitions and container/metaphors. Within each of these categories there are more discrete elements; for example, within the video category, there are full motion video, time lapse, montage, diorama, 2-D animated graphics, 3-D animated graphics, and virtual reality.

As with media, it is the ability of the multimedia attributes to (1) represent symbols and (2) facilitate learner information processing that make it possible for them to contribute to learning. For example, depending upon the learning context in which it is used, multimedia video can make it possible for the learner to:

- Select, interpret and encode ideas
- Understand a problem and its context
- Communicate an individual perspective

It is important to think about multimedia as an interaction between a learner's cognitive processes and the learning environment (Jonassen, 2001). Multimedia can be used in three different kinds of e-learning scenarios:

- To communicate instructional information

- To construct a simulation or learning environment (usually problem- or project-based)
- As a cognitive tool with which learners can represent their understanding through the use of multimedia (Jonassen, 2001).

Why Use Multimedia in Online Learning

The use of multimedia for educational purposes retains all of the pros and cons mentioned previously with media use. An added benefit of multimedia is the ability of multimedia to encourage active learning (Clark & Mayer, 2003). When illustrative pictures (encompassing static pictures including drawings, charts, maps, or photos) and dynamic pictures (such as animation or video) are added to print or spoken text, learners engage in active learning and are more likely to understand the material. That is because representing the material in both words and pictures encourages learners to mentally make connections between the verbal and pictorial representations. Presenting words alone may encourage learners, particularly those who are less experienced, to engage in shallow learning, for example, to not connect the words with other knowledge.

There is more potential for the use of multimedia in the online environment than in previous educational settings. Because the online environment of today has the capacity to deliver multimedia, a systematic approach to providing guidance for *multimedia selection* rather than *media selection* is now needed. Selection issues with multimedia are far more complex than before. *The Empirically Based Guidelines for the Design of Interactive Multimedia* (Park & Hannafin, 1993) describes the necessity of simultaneously presenting information using multiple, complementary formats while structuring instruction to reduce the complexity of the cognitive processing task.

Limiting cognitive load is an important consideration when making multimedia selection decisions (Clark & Mayer, 2003).

Cognitive Learning Theory

Cognitive learning theory is learning theory influenced by cognitive psychology. Cognitive psychology focuses upon how people perceive, learn, remember and think about information. The large scale production of multimedia content and systems in the 1990s and beyond has led to increased scholarship by the Cognitive Sciences community related to the educational efficacy of multimedia (Samaras et al., 2004). Because it is the dominant theoretical influence on current instructional design practice (Smith & Ragan, 1999), a basic foundation in cognitive learning theory is critical to understanding many issues related to the design and assessment of educational multimedia content.

Cognitive learning theory applies the principles of cognitive psychology to the understanding of how people learn. Cognitive learning theory focuses on what people are thinking as they engage in various learning activities. Some typical examples of cognitive learning questions might include how people understand visual information, the reasons people remember some facts while forgetting others, what is involved in learning to speak a language, and the thoughts people have while solving routine problems (Samaras et al., 2004). Because people's thought processes can be hard to determine, the efficacy of learning as defined by cognitive learning theory can be difficult to assess. The general tenets of cognitive learning theory include the following (Ormrod, 1999):

- Cognitive processes influence learning
- People control their own learning
- As children mature, they develop the capacity for increasingly complex thought

- People can acquire new information most easily when they can associate it with things they've already learned
- People organize aspects of their learning, leading to successful integration

Cognitive learning theory assumes that learning involves the formation of mental associations on the part of the learner and further:

- Views learning as an active, constructive process
- Focuses on the presence of high-level processes in learning
- Is concerned with the way that knowledge is represented and organized in memory
- Analyzes learning tasks and performance in terms of the cognitive processes that are involved (Smith & Ragan, 1999).

An important feature of cognitive learning theory is the concept of *cognitive load* (Samaras et al., 2004). Cognitive load is the amount of cognitive processing that a particular task requires of a learner (Foshay, Silber & Stilnicki, 2003), or in other words, the amount of mental resource required by a task (Clark & Mayer, 2003). Cognitive load theory assumes that human memory has two channels for processing information – visual and auditory – and each channel has a limited capacity for processing information (Mousavi, Low & Sweller, 1995). Since multimedia provides input to both the visual and auditory channels, it is important to limit the amounts of input to each channel so neither channel becomes overloaded. For example, it is helpful to accompany visuals with audio narrative rather than text to describe visuals and present content. This splits the input between the audio and visual channels. When learners must use the visual channel to simultaneously process the graphics and the printed words that refer to them, this concentrates the input in the visual channel and may strain cognitive resources. Too much visual input can be particularly difficult for learners when presented at the same time and at a rapid pace (Clark & Mayer, 2003).

Mayer's cognitive theory of multimedia learning (1999) states that when instructional messages are presented in pictorial form, the learner selects relevant features to pay attention to, forms a series of mental visual images, and then organizes the images into a visual mental model. The same thing happens with verbal instructional messages. In the last step, the learner mentally integrates the two models with each other as well as existing knowledge, and learning results.

This theory is based on the integration of several theoretical frameworks:

- Paivio's (1986) information processing theory that stipulates that people have separate information processing systems for visual and verbal material
- Chandler and Sweller's (1991) and Baddeley's (1992) theories that the capacities of the individual and auditory working memory systems are highly limited
- Wittrock's (1989) theory that meaningful learning involves active cognitive processing in which learners select relevant information, organize it into a coherent representation, and make connections between visual and verbal representations and prior knowledge

The cognitive view is based on how new information is processed, stored and retrieved in the learner's mind rather than on how behavior changes as in the behaviorist approach that dominated instructional design practice in the past (Foshay, Silber & Stilnicki, 2003).

Information Processing Theory

Information Processing Theory is an important contribution from cognitive learning theory to instructional design practice. Information Processing Theory describes how learning transforms as it undergoes a process of hypothesized interactions with structures in the brain (Smith & Ragan, 1999). Information processing postulates that the following scenario occurs when a learner successfully interacts with information.

1. The learner receives an unlimited amount of information from the environment through the senses. This information converts to electrochemical impulses and is then sent to the brain where it is stored very briefly in the sensory register. Visual images are stored there for 0.25 seconds, and auditory information slightly longer (Smith & Ragan, 1999). To keep from losing the record, the learner must select it to encode into more permanent memory before it disappears (Lohr, 2003). Because there is more stimulation in the environment than individuals can attend to and encode for further storage, learners can only notice a limited amount. It is most likely that they will select what they expect in a given situation, or they may attend to what is of interest to them because of novelty or because of its connection to what they already know (Foshay, Silber & Stilnicki, 2003).
2. Information that has been selected passes into working memory, also known as short term memory. Working memory, too, is short term and has a limited capacity. It can hold anywhere from five to nine units of information (Lohr, 2003). Its information retention duration is 10 – 20 seconds (Smith & Ragan, 1999). "Chunking" – or grouping – information into manageable sizes helps learners to remember more because information can be stored into fewer units

(Foshay, Silber & Stilnicki, 2003; Lohr, 2003). "Rehearsing" or repeating information extends the duration of the time that information can be kept in working memory. From there it has a greater chance of being kept alive and transferred to long term memory.

3. Meaningful information from working memory passes to long term memory where it is stored. It can be made meaningful through artificial means (such as associating the musical keys in the minor scale with the saying "Frank Brown eats apples daily."). Or it may be meaningful because it is related to prior knowledge. Long term memory can hold an unlimited amount of information indefinitely, some think permanently (Lohr, 2003).

Learners organize information in long term memory based on context and experience. They tend to encode, store, and retrieve information in the way they have used knowledge in the past and expect to use it in the future. Some additional facts about how learners store information in long term memory:

- Information is organized in memory and grouped in a set of structures such as a hierarchy. Such a structure makes remembering easier because while a learner may not remember a specific piece of information in the structure, remembering the overall structure in addition to some items in it may allow the learner to create the missing piece of information.
- Memories seem to be stored as "chunks" with each chunk containing about seven elements
- Verbal and visual information is stored differently in memory. A linear code is used for verbal information. The meaning of verbal information is

> remembered rather than the exact words. Visual information is remembered quite well, especially if there is a meaningful interpretation. Incomplete and strange images are remembered better than standard, complete ones (Foshay, Silber & Stilnicki, 2003).

Information processing theory based on the cognitive approach can be adapted to provide instructional designers with effective ways to design training that promotes higher order thinking, problem solving and transfer to new situations.

Research on Cognitive Learning Theory and Multimedia Learning. Research related to the cognitive dimensions of multimedia has yielded contradictory results, as has educational technology research in general Questionable research designs, varying definitions of multimedia/hypermedia, and the multiple elements of multimedia can confound the research process; additionally it can be difficult to measure cognitive effects as underlying thought processes can be hard to assess (Samaras et al., 2004). While some meta-studies of the broad area defined as "hypermedia" have found that educational multimedia results in positive learning experiences (Ayersman, 1996; Liao, 1999), others have found inconclusive or negative effects of multimedia learning (Dillon & Gabbard, 1998; Hede, 2002).

Liao (1999), for example, did a meta-analysis of 47 studies about the effectiveness of "hypermedia" defined as interactive multimedia, multimedia simulators, and Level III and above interactive videodisks. The studies had been conducted between 1986 and 1998 and were located through objective and replicable searches: 14 studies came from ERIC, 26 from published journals, and seven were from Comprehensive Dissertation Abstracts. Liao found that on the whole, the effects of using hypermedia instruction were positive over non-hypermedia instruction but that the effects seemed to vary greatly depending on the type of instruction to which it was being compared.

Dillon and Gabbard (1998) used experimental studies that emphasized qualitative, empirical methods of assessing learning outcomes in their meta-analysis of 30 published findings related to hypermedia. They defined hypermedia as a generic term covering hypermedia, multimedia and related applications involving the chunking of information into nodes that the learner can select. They found that in general multimedia resulted in insignificant or negative effects, but did find some instances in which the use of multimedia could be advantageous.

This dissertation study took the position that it was fruitless to judge the potential educational value of multimedia on the basis of such meta-analyses based on widely disparate and dated sources (Romiszoski, 1988). It is close to impossible to know the exact details of the applications upon which these meta-analyses were based, but the loose definition of hypermedia in use as well as the dates of the studies indicate that the research was not based upon exemplary educational multimedia applications. These meta-analyses were also not targeted toward evaluating the use of multimedia for facilitating specific types of learning, enabling the research to be meaningful (Romiszoski). Empirical experimental research has conclusively proven that (1) poorly designed multimedia materials can result in negative learning experiences and (2) effective design principles for multimedia have been and are continuing to be discovered (Clark & Mayer, 2003; Reimann, 2002). Because poorly designed multimedia can have negative learning effects, it is critical that multimedia be designed to the highest standard that experimental research has established.

The Application of Cognitive Learning Theory to the Instructional Design of Multimedia. To comprehend the contribution of cognitive learning to instructional design, it is important to understand the respective roles of educational psychologists and instructional designers. In simple terms, educational psychologists develop theories about how learning takes place and build models and run experiments to validate these theories. Meanwhile, instructional designers devise proscriptions for educational interventions (Wilson & Cole, 1996). While initially the field of instructional design was grounded in the discipline of educational psychology, for a number of years the two disciplines were not communicating. In the late 80's the field of cognitive psychology began to address issues of how specifically learning and instruction takes place. In the 90s, multimedia content and applications began to proliferate and became an area of great interest to cognitive psychologists (Samaras et al., 2004). In the 90s, members of the fields of instructional design and cognitive educational psychology again began a dialogue; cognitive psychologists tested models of multimedia learning, and instructional designers kept apprised of this research and came up with guidelines for how instructional design should be practiced in light of these findings (Wilson & Cole, 1996).

The issue of cognitive load has been one of the most important areas of inquiry applicable to multimedia applications. With complex multimedia applications, there is a danger of learning being ineffective because of too much incoming information for the learner to process effectively (Mousavi, Low & Sweller, 1995). Cognitive psychologists have tried to determine the best ways for such information to be presented to make processing manageable for the learner. The Australian cognitive psychologist John Sweller did important early work in relation to cognitive load that has influenced the field of instructional design. Wilson and Cole (1996) did a survey of cognitive psychology learning models that can be applied to instructional design practice; in it, they cited a study by Sweller (1985) that found that, due to issues of cognitive load, worked examples are a much more effective way to teach algebra than the way it is traditionally taught: through the presentation of a principle, concept, or rule followed by extensive practice with problems. Sweller hypothesized that the reason for this is that worked examples focus attention on problem-state situations and their solutions instead of directing attention toward a problem.

Wilson and Cole (1996) extracted instructional guidelines from the cognitive load research, including Sweller's, that they surveyed. Details of the works that they surveyed and their methodology were not made clear, but the instructional guidelines that they extracted emphasize the following practices:

- Careful analysis of the attention demands of instruction to avoid too many simultaneous elements
- Use of single coherent representations that allow the user to focus rather than split attention
- Eliminating redundancy
- Providing problem-space exploration (such as worked examples) rather than conventional practice
- Presenting animation and audio narration (or text description) simultaneously rather than sequentially

Park and Hannafin (1993) also surveyed what they classified as cognitive empirical research and came up with 20 guidelines related to instructional design practice. While the works that they surveyed are all highly credible, the authors did not distinguish between whether the writings were actual experimental finding or theories. As a result of their survey, Park and Hannafin supported the use of multiple media but echoed the cognitive load concerns of the other authors, advising the structuring of educational materials to complement cognitive processes and reduce the complexity of learner processing.

Richard Mayer has been unusual as a cognitive instructional psychologist because unlike many researchers who are primarily concerned with communicating to other researchers in their own fields, Mayer has extracted guidelines from his abundant research that are useful to instructional designers, thereby serving as a bridge between cognitive psychology and the instructional design community (Reimann, 2002).

Studies by Mayer and colleagues also supported the premise that learning is affected by cognitive load issues. Over a period of ten years, Mayer and colleagues conducted over 40 studies with students at their U. C. Santa Barbara lab (Mayer, 1999). They compared two ways of designing multimedia messages – well and poorly designed according to their hypotheses – to teach scientific and mathematical explanations for both text-book and computer-based teaching situations. Their test subjects had no prior knowledge of the subject. After receiving the multimedia message, students were assessed on tests of problem solving transfer. Gain scores were computed by dividing the mean number of creative solutions generated by the group receiving the well-designed multimedia presentation by the mean number of creative solutions generated by the comparison group. Testing affirmed the researchers' hypotheses, and they concluded that greater learning results when multimedia attributes are designed in proscribed ways that have been validated by research (Clark & Mayer, 2003). Mayer (1999) discovered that the following multimedia features result in better learning:

- When learners receive words and corresponding pictures rather than words alone (multimedia principle)
- When words and corresponding pictures are presented near rather than far from each other on the page or screen (spatial contiguity principle)
- When words and corresponding pictures are presented at the same time rather than at different times (temporal contiguity principle)
- When words are presented as narration rather than as on-screen text (visual split-attention principle) (Note, however, that accompanying visuals with auditory information is not always most effective cognitively. At times, text words – such as mathematical formulas or directions – are needed by the learner for memory support.)
- When concurrent non-verbal auditory information is minimized rather than maximized (auditory split-attention principle)
- When alternating visual and verbal information is presented in short rather than long segments (chunking principle)
- When extraneous material is eliminated rather than included (coherence principle)
- When learners have low rather than high prior knowledge and high rather than low spatial ability (individual differences principle)

Cognitive load is a primary issue to consider in the assessment of multimedia online resources (Cohen, 2004). These cognitive guidelines, while providing guidance for the design of multimedia, can also be used in the reverse to assess online resources. In analyzing an online resource, an assessment should be made of whether cognitive load issues have been considered in its design and whether its cognitive processing demands seem prohibitive.

Summary

A review of the literature suggested that faculty must learn new skills to transition into online teaching, both as course designers and instructors. Among these skills is the ability to implement e-learning features including use of media elements such as words and pictures to deliver content. Since designing such media assets is beyond the means of most faculty, selecting from available digital resources is another option for including these valuable resources in an online course. Many educational resources exist online that can be incorporated into online classes. While large amounts of money have been invested in these resources, educators have been slow to adopt them. Instructional designers can facilitate the adoption of online resources, collaborating with faculty members to select such materials based on sound instructional design principles.

Colleges are increasingly hiring professional instructional designers to work with faculty to design and develop online course materials and to serve as change agents, diffusing technological innovations into education and facilitating changes in how academics think about teaching and learning. The literature suggested that instructional design theory needs to be much more grounded in instructional design practice, particularly in the recent area of online higher education and working relationships between instructional designers and faculty online course designers. The literature suggested that through working with effective instructional designers, faculty members can increase their knowledge of the instructional design process.

Knowledge of the instructional design process, a major focus of the evolving field of Instructional Design and Technology, makes skilled online course design, including media selection, possible. Prior to the distribution of online courses, Instructional Design and Technology theorists developed criteria for media selection; these criteria can form a foundation for making decisions about which online resources should be selected for inclusion in online courses. The online environment often results in the use of multimedia, two or more media presented simultaneously. Multimedia selection differs from media selection because issues of cognitive load must be considered. Considering the instructional attributes of media and how learners cognitively integrate information provides a foundation upon which to assess whether to use and how to implement online educational resources in online courses.

Chapter 3

Methodology

Overview

This chapter identifies the methodology and specifies the procedures used in this study, the purpose of which was to address a three-fold problem:

- The lack of online pedagogical skills possessed by online faculty
- The less than effective deployment of the college-employed instructional designers hired by colleges and universities to work with online faculty
- The lack of educator adoption of online resources, particularly learning objects and learning object repositories

The study was designed to answer the following research questions:

1. What steps are necessary to develop a process script that will help instructional designers guide online faculty in selecting online resources for their online classes?
2. What requirements must that script satisfy in order to be considered successful?
3. What will be a functional format and composition to enable the script to meet the specified requirements?
4. How can a set of requirement candidates be established?
5. How can the requirements be validated?
6. How can the process script be evaluated?

This chapter discusses the methods and procedures used to answer these research questions, resulting from the following study phases:

- Answers to research questions 1-3 and 5 were compiled throughout the study and completed in the last phase, Summative Evaluation
- Question 4 was answered in the Design Phase
- Question 6 was answered in the Summative Evaluation Phase

The chapter concludes by identifying the resources required by the project and specifying the measures taken to ensure research reliability and validity.

Research Methods

Development methodology was used in the study. This study fell into the category of applied research in that it lent itself to the immediate solution of a practical problem (Richey & Nelson, 1996). These authors stated that one form of research knowledge is process knowledge. The study developed a process on which the Online Resource Selection Instructional Design Script (ORSIDS) was based. Thus the study of the development of ORSIDS is an example of applied research in the category of process knowledge.

Richey and Nelson (1996) divided the instructional design developmental research process into three stages: Design, Development, and Utilization and Maintenance. These research stages correspond with the stages in the development of an instructional design product. Gibney (2000) divided the developmental research process into:

- Literature review and other information gathering
- Establishing formative and summative review committees

- Criteria development
- Criteria validation
- Product development, and
- Product validation procedures (commonly referred to in the instructional design field as evaluation)

Because this study involved the development of an instructional design product, the procedures for this dissertation study were based on a combination of applicable procedures from the Richey and Nelson and Gibney models. The Richey and Nelson phases were added to and amended to include the Gibney model processes. The *Pre-Design Phase* consisted of the review of literature and other information gathering. Establishing formative and summative review committees also occurred in this phase. The *Design Phase* consisted of requirements development and validation. In this phase members of the Expert Panel validated the candidate requirements proposed by the researcher. The alpha version of the product was also designed in this phase. In the *Development Phase*, the product was developed and then refined utilizing field testing with a sample of one of the user populations, Online Instructors. Field testing was followed by a pilot study with a sample of a different user population, Instructional Designers working with Online Faculty, to continue to gather input about the process script. *Product evaluation* was ensured though summative evaluation by the Expert Panel.

Richey and Nelson's *Utilization and Maintenance* phase (1996) was outside of the scope of this study although recommendations resulted for future implementation of the product.

The following design artifacts were developed in the process of conducting the study:

- Pre-Design Phase
    - ✓ Requirement Candidates (Appendix A)
    - ✓ Content for ORSIDS (Appendix B)
        - Instructional attributes for media types
        - Cognitively based findings related to instructional message design
- Design phase
    - ✓ Validated Requirements (Appendix C)
    - ✓ System Requirements Document (Appendix D)
    - ✓ Basic Content Outline (Appendix E)
    - ✓ Detailed Content Outline (Appendix F)
- Development phase
    - ✓ Three alpha versions of ORSIDS
    - ✓ Results summaries of field tests
    - ✓ Beta version of ORSIDS Script
    - ✓ Completed ORSIDS Observation Recording Forms (Appendix G)
    - ✓ Completed Cognitive Walkthrough Forms (Appendix H)
    - ✓ Results summaries of one-to-one observations
    - ✓ Observation Report (Appendix I)
    - ✓ Abbreviated Validated Requirements and Their Implementation in ORSIDS (Appendix J)
    - ✓ Final draft of ORSIDS Script (Appendix K)

- ✓ Summative Evaluation Questionnaire (Appendix L)

Rapid prototyping was employed in this study. Rapid prototyping is a process in which a prototype product is quickly developed in the early stages of an instructional design project and then goes through a series of rapid tryout and revision cycles until the final version is produced (Reiser, 2002a). Rather than using an approach in which the instructional design phases are distinct, in rapid prototyping the following phases may be overlapped: Analysis, Design, Development, and Formative evaluation (Smith & Ragan, 1999).

Pre-Design Phase

The Pre-Design phase consisted of a literature review and an expert interview. Formative and summative review committees were also established in this phase.

The Literature Review

The following outputs resulted from the literature review:

- Requirements candidates for an effective process script for online resource selection (Appendix A) including proposals for how to treat and prioritize the following elements related to process script format and composition:
  - ✓ The format with which to present the script
  - ✓ Which media and media attributes to include
  - ✓ Which learning outcome categories to include
- Content needed for the product, including the instructional attributes related to various media types and cognitively based findings related to instructional message design (Appendix B)

The Expert Interview

Steven Smith is a Manager of Instructional Media Services at Portland Community College and routinely helps online faculty select online resources for their classes. Unlike the Expert Panelists whose expertise related to online resource selection tended to be more academic and theoretical, Smith had developed mastery of the practical process of online resource selection. For this reason, he was chosen as an expert interviewee. The expert interview resulted in information about the consulting process used by an expert in aiding online faculty in finding and selecting appropriate online resources for their classes. Information about the expert interviewee is located in Appendix M: The Expert Panel, Expert Consultants, and Expert Interviewee.

Establishing Review Committees

In the pre-design phase, the researcher established several committees for the purposes of requirements validation, formative evaluation of the product and summative evaluation of the product (Gibney, 2000). The breakdown of the groups was as follows:

- Expert Panel Members (Smith & Ragan, 1999) for requirements validation and summative evaluation
- End user population sample to participate in formative evaluation
- End user population sample to participate in a pilot study

The Expert Panel consisted of three members with expertise in (1) instructional design for distance learning, (2) educational multimedia development and use and (3) faculty development for technology integration. There were two additional Expert Advisors. The Expert Advisors had substantial practical experience in faculty technology integration as well as strong academic instructional design credentials. They were not, however, available to attend the face-to-face requirements validation meeting. To simultaneously maintain sound requirements validation methodology and yet tap the expertise of these professionals, these experts were utilized as advisors rather than panel members. The role of the Expert Advisors was limited. They reviewed an early draft of the criteria requirements prior to submission to the Expert Panel. One of the Expert Advisors also reviewed sample questionnaire questions.

The Expert Panel Members and Advisors were chosen for several reasons. First of all, their experience and expertise related directly to the topic under consideration. Additionally, they were chosen because they specialized in somewhat different areas within the instructional design, multimedia, and faculty development fields. It was expected that such an expert panel composition would not only enhance the creative process but would also increase the possibility of developing uniquely effective requirements (Delbecq, Van de Ven & Gustafson, 1975). See Appendix M for further information about the backgrounds of the individual Expert Panel and Expert Advisors.

Subjects were recruited to serve as two end user sample populations for formative evaluation of the product. There were actually two types of end users for this product: the primary users, the Instructional Designers, who actually administered the script and the secondary users, the Online Faculty, to whom the script was administered. These two types of users were recruited to assist with formative evaluation consisting of field testing and a pilot study. Two Instructional Designers were recruited through the American Society for Training and Development (ASTD) Cascadia Chapter e-Learning SIG. The secondary subjects were four Faculty Members; two of them already taught online, and two had not yet done so. The field testing and pilot testing each utilized one experienced online instructor and one inexperienced. These Faculty Subjects were representative of the secondary target population for this product. The Faculty Subjects were instructors from Portland State University (PSU), the Pacific Northwest College of Art (PNCA), and the Blosser Center for Dyslexia Resources. PSU is a large urban university, PNCA is a small urban four-year college, and the Blosser center is a small nonprofit organization that provides classes to teachers in the Orton Gillingham Method of reading instruction. The study underwent the Institutional Review Board approval process to ensure the safety of these subjects (see IRB Approval, Appendix N). The subjects received and signed the IRB Informed Consent Form (Appendix O) that informed them of the confidentiality provided by the study. Due to privacy considerations, the names of these subjects are not listed and their qualifications are discussed in the aggregate.

Design Phase

In the Design Phase, requirement candidates were submitted to the Expert Panel Members (Smith & Ragan, 1999) for validation. The researcher took advantage of an exceptional opportunity afforded by the occurrence of the national AECT conference to convene the Expert Panel before the study had officially commenced. Several meetings dedicated to validating the ORSIDS requirements using the Nominal Group Technique (NGT) process (Delbecq et al., 1975) took place at the 2004 AECT Conference. An alpha version of the product was designed based upon these validated requirements.

Requirements Validation

The importance of requirements is that their use makes it possible to assess the success of a developmental research project at the end of the study. A first draft of requirement candidates was developed by the researcher and sent to the Expert Panelists and the researcher's Dissertation Advisor for feedback (see Appendix A, Draft 1). Based on this input, revisions were made to the requirements, and a second draft was the result (see Appendix A, Draft 2). The researcher's Dissertation Advisor provided further input, resulting in Draft 3 (also located in Appendix A). These requirements candidates were emailed to the Expert Panel nine days before the meeting, and the Panel Members were asked to review them. The Expert Panel was also provided with an agenda, and informed of the project background, the desired outcomes, the meeting location, and the group decision making process that would be used. See Appendix P for an example of the communication that was sent.

The researcher took additional actions at this time to ensure the effectiveness of the requirement validation meeting (Strauss, 1999). These actions included determining the ground rules for meeting activities and how group decisions would be made.

To prepare for the meeting, the researcher prepared a Preliminary Proposal Review Worksheet (see Appendix Q for an example) and made copies, prepared the room to make sure that everyone had a comfortable spot to sit and write, bought and prepared lunch, and got the necessary supplies for the NGT process including a flip chart, a roll of masking tape, a pack of 3 X 5 cards, and a large felt tip pen (Delbecq et al., 1975).

At the meeting, the researcher opened with an introduction of the Members and a welcoming statement clarifying the meeting objectives and the role of the Expert Panelists in attaining those goals. Questions regarding the project and the materials that were sent out were also entertained. The meeting used a customized NGT process, the

Proposal Review Process, to arrive at requirement validation. NGT has several characteristics that distinguish it from other problem-solving group methods:

- Individuals work alone before group discussion
- Round robin reporting is used to share each group member's ideas
- Clarification of these individual ideas is provided through a structured group discussion
- Specific solutions are derived from responses by ranking and polling items
- The work occurs in a face-to-face meeting format (Davis, Rhodes & Baker, 1998).

The standard NGT process has several features that made it inappropriate for this meeting's purposes. The output of the standard NGT process is a limited number of five to ten requirements ranked by priority (Delbecq et al., 1975). The purpose of this meeting was not necessarily to reduce the 26 proposed requirements but to validate them, and in the process to possibly eliminate some requirements and to potentially introduce others. Thus the standard NGT process was not suitable for the purposes of this meeting. Additionally the standard process would have been too time consuming for the allotted time if each requirement were to be considered individually.

A customized NGT process, the Proposal Review Process, is recommended for planning situations and specifically proposal review (Delbecq et al., 1975). The NGT Proposal Review Process is directed toward identifying the strengths and weaknesses of proposed solutions and provides a vehicle to introduce modifications that would improve it. This process was selected for use with this study's Requirement Validation Meeting because in validating the requirement, the Expert Panel was essentially assisting with product planning and reviewing a proposal developed by the researcher.

The NGT Proposal Review Process utilizes the Preliminary Proposal Review Worksheet (Delbecq et al., 1975), a form that was modified for use in this meeting (see Appendix Q). The modification that was made was the elimination of the third column, *Sources of Assistance*. This third column is useful in circumstances where the reviewers are stakeholders who can provide additional resources to implement suggestions. As this was not the case in this circumstance, the third column was not applicable. The NGT Proposal Review Process retained the positive features of NGT including structured group decision making. Additionally this deliberate structured process provided a way to:

- Identify crucial features of an innovative solution by focusing on problematic aspects apparent from prior problem exploration
- Facilitate the creation of an original concept of solution elements rather than relying upon past models
- Incorporate multi-organizational and interdisciplinary participation (Delbecq et al.).

The meeting events occurred as follows:

- Welcome
- Questions
- Verbal definition of roles
- Distribution of Preliminary Proposal Worksheet and duplicate copies of Requirement Candidates materials

- Independent completion of the worksheets by group members listing modifications that needed to be made to the document
- Then group work followed consisting of the following: individual round robin reporting and discussion and clarification of individual items until consensus was reached. (While the NGT process usually includes preliminary voting, discussion of the vote, and a final vote, this small group was able to achieve consensus through discussion alone, eliminating the need for these steps).

Because of the richness of the dialogue, validation of the requirements required two additional meetings beyond the initial scheduled meeting which was extended in length by a half hour. Only two of the three Expert Panel Members were available to attend each of the additional meetings. To compensate for these absences, at each meeting the researcher informed the Member who had been previously absent of the decisions made in his or her absence and asked for agreement or disagreement. After the conference meetings were over, the researcher summarized the decisions in an email and sent it to the Panel Members for their approval. An email dialogue ensued until the group achieved agreement. This process resulted in a list and an understanding of the validated requirements on the part of the researcher and Expert Panel members (see Appendix C).

Design of the Alpha Product

As a result of rapid prototyping, many tasks that often occur in the Analysis and Design Phases were accomplished in an abbreviated form in the information-gathering activities of the pre-design phase and in the processes of requirements development and validation. These tasks included defining goals and conducting task analyses and learner and context analyses (Smith & Ragan, 1999). After requirements development and validation, design of the alpha product began. A System Requirements Document was prepared (Appendix D). A basic and then detailed outline for the script was also created based upon the validated requirements (see Appendices E and F). From the detailed outline, an alpha version of the process script was designed in the Development Phase by the researcher, an experienced instructional designer.

Product Development Phase

Overview

In this phase, the product was developed through iterative cycles of development and formative evaluation. An alpha version of the product was developed and then underwent formative evaluation consisting of two cycles of usability field testing with Online Instructors, subjects from the secondary user group. On the basis of the feedback from the first session, a second alpha version of the script was developed. Then on the basis of the feedback from the second session, another alpha version of the script was developed. This third alpha version was provided to the Instructional Designers during training prior to their participation in pilot testing. On the basis of their comments during the training, revisions were made, and the beta version of the script was developed. A requirements-tied Observation Checklist (Appendix G) was also developed. The beta version of the script was used in the pilot study as was the Observation Checklist. (Note that due to space considerations, the alpha and beta scripts do not appear in the Final Report - only the Final Script is displayed in Appendix K).

The pilot study utilized the nonparticipant, naturalistic observation method (Gay & Airasian, 2000) and consisted of two rounds in which an Instructional Designer used the script with an Online Faculty Member. This pilot study, too, resulted in refinements to the product. Both groups of subjects received necessary training prior to participating in formative evaluation. A more detailed explanation of these product development processes is presented below.

Development of the Alpha Version of the Product

In this phase, a draft was written based on the detailed outline (see Appendix F) developed in the design phase. Additional research was done to provide the information necessary to flesh out content dictated by some of the requirements. This draft, an alpha version of the script, provided input to the first round of formative evaluation.

Prerequisite Training for Faculty Subjects

Knowledge of the Analysis phase of the instructional design process equivalent to Steps 1 and 2 of the ASSURE model (Smaldino, Russell, Heinich, & Molenda, 2005) is prerequisite knowledge (Dick, Carey & Carey, 2000; Smith & Ragan, 1999) necessary to engage in online resource selection. The faculty members who comprise the target audience for this process will for the most part be unfamiliar with this Analysis Phase. As the secondary end user population sample was representative of this group, three of the four did not have this prerequisite knowledge. This prerequisite knowledge had to be supplied to them in order for them to be effective testers of this script.

Prior to the usability testing and pilot study, the Faculty Subjects were given training in the Analysis phase of the instructional design process. This training was provided close to the time that they would be testing so that the content would remain fresh in their minds. The content for the training was derived from the ASSURE instructional design model (Smaldino, Russell, Heinich, & Molenda, 2005). The Faculty Training Materials are located in Appendix R.

Alpha Version Usability Field Testing: Cycles One and Two.

The first phase of formative evaluation consisted of two usability field tests (Shneiderman, 1998; Smith & Ragan, 1999) conducted with individual members of the Online Faculty end user population sample. The subjects were representative of the user population because they were experienced face-to-face instructors and they were interested but inexperienced in the selection of online resources. One of the subjects had limited experience with teaching via teleconference but no other experience with technology-based teaching while the other was experienced with online instruction but not with the selection of online resources. Due to privacy considerations, information about these subjects was previously provided in the aggregate.

The usability testing consisted of a field test (Shneiderman, 1998) in which the researcher conducted a trial run of a consulting session using an alpha version of the process script. The purpose of this field test was to give the researcher the opportunity to use the new product in a realistic environment. This provided the researcher with first-hand knowledge of use of the script, revealed gross errors, and provided insights into the reactions of the secondary users, the Online Instructors. Originally the researcher planned to use the Think-Aloud Protocol (Jonassen, Tessmer. & Hannum, 1999) to capture the subjects' reactions to the script. This protocol was briefly tried, but its use was discontinued when it became apparent that it was impossible for the first Subject to simultaneously engage in the Think-Aloud Protocol and the necessary interaction with the researcher. It also became clear that there was no need for the think-aloud protocol as the Subject's reactions to the script were revealed through questions regarding the process. Additionally the primary reason for doing the usability testing was not to gather Online Faculty reactions but to give the researcher the opportunity to "walk in the shoes" of the primary subjects, the Instructional Designers, and to eliminate obvious problems prior to turning the scripts over to them.

The researcher recorded each session and then transcribed the meaningful portions. The results of the two cycles of usability testing helped the researcher to refine the product, resulting in two revised Alpha versions of the process script. The results of this testing provided insights to the researcher that made it possible to develop the Observation Checklist (see Appendix G) used later in the pilot test.

Prerequisite Training for Instructional Designer Subjects

Preceding the pilot study, two Instructional Designers were trained on use of the process script and supplementary materials. (See Appendix S for the Instructional Designer Training Materials.) The training was based on discussion of the script and modeling its use. In the training, the Instructional Designers were also apprised of the training given to the Faculty Members. The Instructional Designers were given the script to review prior to the meeting. The researcher listened to their feedback and made changes to the script based on it.

Pilot Testing of the Beta Version

In the pilot study the Instructional Designers used the script with one Online Instructor each to assist him or her in selecting online resources for a real or potential course. Each pilot test took place in one 3 - 4 hour session.

These sessions were observed by the researcher using Nonparticipant, Naturalistic Observation (Gay & Airasian, 2000). The purpose of observation was to assess the usability and effectiveness of the process script, focusing upon various target events and the interaction process between representatives of the two user samples. Observation was an appropriate research method for this study because it made it possible to document the interactive behavioral processes that occurred with use of the script (Brewerton & Millward, 2001). The Nonparticipant, Naturalistic Observation Method makes it possible to examine behavior as it naturally occurs and tends to provide a true picture of those being observed. (Gay & Airasian). Use of this observation method made it possible to record and study the behavior arising from the use of this process script. The insights gained from this observation method made it possible to make further needed changes to the process script.

The researcher filled out an observation checklist, the ORSIDS Observation Recording Form (see Appendix G) and additionally videotaped these sessions for later review (Gay & Airasian, 2000). The observation checklist made it possible to methodically record assessments of the critical elements of the process (Gay & Airasian). The checklist provided a means for the researcher to assess whether the script made it possible for the Instructional Designer to fulfill the validated task-related requirements. Three aspects of each criterion-related task were evaluated: whether the Instructional

Designer explained the task clearly, whether sufficient detail was provided, and whether the Online Instructor was ultimately able to accomplish the task from the information provided. The checklist additionally made it possible to record information about the overall quality of the session, technical accommodations, and suggestions for script development and revision. The checklist was based on the *OMST Guidance: Teaching Observation Recording Form* at www.derby.ac.uk/staffdev/policy/omst/omst-rec-form.pdf

Since there was only one observer of the pilot tests, the sessions were videotaped and audiotaped to improve the validity and reliability of the process. Videotaping and audiotaping resulted in tapes that could be replayed, easing the recording task which can become difficult when observed behaviors are complex and/or occur at a rapid rate. The ability to refer to a videotape helped to make the judgments and evaluations derived from observation as reliable as possible (Gay & Airasian, 2000). Audiotapes were made to back up the videotapes. These videotapes and audiotapes were securely stored so that only the researcher could access them. The tapes were destroyed upon completion of the dissertation.

Post Pilot Test Learner Validation

After each pilot testing session, the researcher and Instructional Designer debriefed the session. To do so, they engaged in a form of Learner Validation, a One-to-One Evaluation of the process script (Smith & Ragan, 1999). The researcher used a Cognitive Walkthrough Form (Appendix H) based largely on the same criteria as the Observation Checklist to record the results of these sessions. Like the Observation Checklist, the Cognitive Walkthrough Form was built around the process steps and the product requirements. However, the purpose of this form was to capture the Instructional

Designers' assessments of the usability of the script and thus included dimensions such as pleasingness, ease of learning and remembering, efficiency of use, amount of errors, and whether the script offered too much or too little guidance (Nielsen, 1990, as cited in Lee, 1999). The form also surveyed Instructional Designer feelings about format, and asked whether the script facilitated the tasks of teaching instructional design skills and finding online resources.

Using the One-to-One Evaluation process, the researcher queried each Instructional Designer. While originally the researcher had proposed using a Think-Aloud protocol, it became clear that use of the protocol in this situation would offer the same obstacles as it did with usability testing, and that a structured interview would suffice to gather the needed information (Gay & Airasian, 2000). The Instructional Designers provided feedback including the aspects of the script that proved problematic during the pilot study sessions. The researcher used the Cognitive Walkthrough Form (Appendix H) to record each subject's feedback. The process script was again refined on the basis of this testing and feedback.

Development of Summative Evaluation Materials

A combination of systematic learner observations and survey techniques is a common evaluative methodological approach for what Richey (1997) classifies as Type 1 Instructional Design Developmental Research. This study falls into that category which consists of studies that examine design and development procedures for instructional products, evaluate the products that are created, and examine the changes in learners who use the products. Therefore this study used the evaluative approach of combining systematic learner observations and survey techniques. The researcher developed a questionnaire (see Appendix L) to assess how well the Expert Panel members thought that the requirements had been implemented, whether the panel members still agreed with the original requirements, their assessment of the overall quality of the process script, and their evaluation of how well the process script contributed to the solution of the problems that the dissertation was designed to address. It included the criteria of accuracy, appropriateness, usability, bias and efficacy proposed by Henderson, Noell, Reeves, Robinson and Strecher (1999) as important dimensions of information programs. The questionnaire consisted of focused and open-ended questions. These questions were reviewed by an Expert Advisor for clarity (Gay & Airasian, 2000). The focused questions were included to make it possible to thoroughly analyze the panel members' subjective judgments. These questions were designed with a framework consisting of the following components (Fowler, 1995):

- What is to be rated
- The continuum on which the rated object is to be placed
- Characteristics of the continuum

The inclusion of a Likert Scale allowed Components 2 and 3 of the above framework to be addressed. A Likert scale makes it possible for users to express their attitudes by indicating the extent to which they agree or disagree with a series of statements (Gay & Airasian, 2000). Each response is associated with a point value. By totaling the points, a score can be determined. Open ended questions were also included to provide an opportunity for the Expert Panel members to directly state their judgments and the reasoning behind them (Fowler, 1995).

The researcher wrote an Observation Report (see Appendix I) based upon the completed observation checklists, Cognitive Walkthrough forms, videotapes and summaries of results from the One-to-one Evaluations. The researcher also wrote *Abbreviated Validated Requirements and their Implementation in ORSIDS*, a document discussing the requirements and how they were implemented (see Appendix J). The Observation Report and final version of the process script were emailed to the Expert Panel for evaluation along with the requirements document and summative questionnaire.

Product Evaluation

After pilot testing took place, the final product received a summative evaluation by the Expert Panel. Expert Panel Members were asked to read the Observation Report (see Appendix I) and review ORSIDS, rating the script against the initial requirement to provide any suggestions for changes to the process script. The Expert Panelists' ratings and suggested changes are reported in Chapter 4 of the Dissertation.

Resources Used

The following resources were required:

- Panelists expert in instructional design, online faculty development, and multimedia development to validate product requirements and conduct the summative evaluation
- An experienced instructional designer to develop the script
- Online faculty to participate in formative evaluation including field testing and a pilot study
- Instructional designers to participate in the pilot study

- Assistance from a video specialist
- Computer and video resources

Formats for Presenting Results

Results are presented in Chapter 4 in a descriptive qualitative research narrative. Various appendix items supplement the narrative.

Reliability and Validity

The methodology design contained a number of techniques to ensure the reliability and validity of the study (Gay & Airasian, 2000; Morse & Richards, 2002). They included:

- An extensive review of literature. This literature review contributed to a strong set of requirements candidates and identified what was known and what needed to be researched in the field.
- Use of the Nominal Group Technique for requirements validation
- Use of the Analysis phase of the ASSURE method as a foundation for the prerequisite training of the online faculty
- Videotaping and audio recording pilot study sessions as backups for observation
- Review of a sample of the questionnaire questions by an Expert Advisor
- Basing the design of observation and survey instruments on other applicable instruments and incorporating the evaluative measures used in other valid studies

Additionally, the execution, as well as the design, of the study included measures to increase reliability and validity such as responsiveness to , and willingness to change, strategies that were not working (Morse & Richards, 2002).

Summary

This chapter presented the methodology and procedures used in this study to answer the research questions. This study utilized rapid prototyping and a development methodology to develop an instructional design product. The study included formative evaluation consisting of field testing and a pilot study and summative evaluation by the same Expert Panel that validated the initial requirements.

The chapter also identified the required resources as well as the measures taken to ensure reliability and validity.

Chapter 4

Results

Introduction

This chapter discusses the study results. It presents the findings from each of the study's phases and provides an analysis of the data discovered in each phase. Then it summarizes the results of the study.

Data Analysis and Findings

Pre-Design Phase

Data from the Pre-Design phase resulted from a literature review and an expert interview. The deliverables from this phase included the requirements candidates for an effective process script for online resource selection (Appendix A) and some of the content needed for the product (Appendix B).

The literature review was quite extensive and provided much of value. The literature review contributed to the study in a number of major ways. It provided guidance for the development of the process and specifically the instructional design steps to include. The media selection literature (Briggs & Wager, 1981; Kemp, 1980; Reiser & Gagne, 1983; Reynolds & Anderson, 1992; and Romiszowski, 1988) was an important influence. Media selection models are based on sound instructional design principles and delineate simple, systematic processes for making media selection decisions. Initially the researcher thought that ORSIDS would be based on one or a combination of these media selection models. However, these models ultimately did not seem to be as useful or practical in an applied environment as the less proscriptive and more open-ended ASSURE model (Smaldino, Russell, Heinich & Molenda, 2005). However, the media selection literature did influence many of the requirements candidates.

The ASSURE model (Smaldino, Russell, Heinich & Molenda, 2005) provided a strong foundation for this study. Like the other media selection models, the ASSURE model deals with issues of media selection but can be applied more flexibly and allows for more creativity on the part of instructors. ORSIDS is essentially an extension of ASSURE customized for instructional designers working consultatively with faculty members in the online, higher education environment. The ORSIDS candidate requirements (Appendix A) reflected many elements of the ASSURE model.

The review of literature also provided a context in which to think about the role of college-employed instructional designers and how best to support them in their relationship to online faculty. The works of Schweier, Campbell and Kenney (2004); Pan, Deets, Phillips and Cornell (2003); Torrisi-Steele and Davis (2000); Ellis, Hafner and Mitropoulos (2004); and Liu, Gibby, Quiros and Demps (2002) were significant in discussing some of the challenges and role ambiguities faced by college-employed instructional designers as well as their potential role, if properly supported, as change agents facilitating the promise of technology-based learning. These works documented the changes in the instructional designer's role now that they are working in colleges and find themselves at the helm of the development of multimedia projects. They also discussed the lack in the instructional design literature of documentation of what instructional designers actually do and the need for such documentation. This literature contributed to the candidate requirements by justifying the need for such a product and providing a foundation for understanding the instructional designer role in the college setting.

The writings of Keppel (2004) on the necessity of instructional designer protocols, or scripts, also made a major contribution to this study. Again this literature contributed to the candidate requirements by justifying the need for such a product. It also suggested a possible format, a script. This study actually developed such a script and tested its use.

The review of literature also provided an understanding of the most constructive ways with which to think about the design and use of multimedia and the role of instructional message design. The work of several authors (Djikstra, Jonassen, & Sembill, 2001; Jonassen, 2001; Kozma, 2001b; and Rouet, Levonen & Biardeau, 2001) made major contributions to the approach towards multimedia used in this study and the understanding of multimedia uses underpinning several candidate requirements. Mayer (1999) wrote of empirically valid scientific studies that proved the relationship between the design of instructional messages and how people do or don’t learn from them. Mayer’s work on instructional message design was an important philosophical underpinning of this study and underlay several candidate requirements. Additionally the Expert Interview with Steven Smith (2004) contributed an online searching technique that formed the foundation for one of the candidate requirements.

Design Phase

Requirements Validation. The requirements candidates (initially called criteria candidates – the term was changed on the advisement of the researcher’s dissertation committee) went through two revisions prior to the draft that was placed before the Expert Panel for validation (Appendix A). Draft one was a two-page document consisting of ten criteria with several additional sub-criteria on one page. A list of references appeared on the second page. The criteria were stated as actions that the script would perform, such as “helps”, “is”, “provides”. This draft was reviewed by the researcher’s dissertation advisor and the Expert Advisors.

As a result of their comments, Draft two was expanded to a three page document containing 26 criteria. Several sections were added: *Background Information* and an *Introduction*. The criteria were divided into Process Inputs, Process Steps, Process Outputs, Format, Reference Materials and Efficiency/Cost of Using the System. The criteria were now stated as nouns, or attributes, of the script. Draft 3 was very similar to Draft 2; the only changes were wording revisions suggested by the researcher’s dissertation advisor to more clearly state the criteria in the form of criteria.

Draft 3 of the product criteria, or requirements (Appendix A), was placed before the Expert Panel. The Expert Panel made some suggestions for additions and one deletion; their primary contribution was to introduce many modifications consisting of amplification and added specificity to the requirements candidates. In the main, this specificity related to the context in which the process would actually be used. There was some discussion related to instructional design methodology and the order in which some of the process steps should take place. This was resolved by agreeing to state that several of the steps were ordered optionally and could take place in a different order if desired. The panel found the original criterion #8, “whether the resource meets the conditions of learning required by the curriculum area” hard to understand and replaced it with “whether the resource can fulfill the learning outcome task analysis requirements”. Stating that issues related to return on investment (ROI) were outside of the scope of this study, the panel eliminated Criteria #26, “Use of the system will be more efficient and cost effective than conducting the same task without it”, and replaced it with “Is the online resource affordable?” The panel also recommended the inclusion of instructional message design guidelines from Fleming and Levie (1993) in addition to those from Mayer (1999). Appendix T contains a table showing the original requirements and the changes made to them by the Expert Panel in the validation process: *Changes Made to ORSIDS Requirements During Validation*.

Design of the Alpha Product. After requirements development and validation, design of the alpha product began. A System Requirements Document was prepared. A basic and then detailed outline for the script were created based upon the validated requirements.

The Systems Requirements Document (see Appendix D) consisted of an analysis of the learning context for both groups of learners served by the script, an analysis of both groups of learners, analyses of the learning tasks, or goals, and a list of the validated product requirements.

The basic outline was based on the validated process requirements which encompassed the script’s contents as well as its format (see Appendix E).

The detailed outline (Appendix F) went into more depth for each item. It was essentially based upon visualizations by the Instructional Designer of the necessary interaction between instructional designer and faculty member for each requirement to be implemented satisfactorily. More research had to be conducted in order to flesh out some of the validated requirements. For example, one challenge included determining the classification scheme to use for the learning outcome types. While the researcher had planned to utilize the Gagne learning outcome classification system (cited in Gagne, Briggs & Wager, 1992), some lingering questions emerged about whether all kinds of learning could really be covered by those categories. The researcher made the decision to add Romiszowski's "aesthetic" category (Romiszowski, 1988), a learning outcome category for arts subjects, in order to make the classification scheme as comprehensive as possible. Another challenge was figuring out how to tie the learning outcome types to the methods. The researcher developed links between the two by going through literature (Dabbagh & Bannan-Ritland , 2005; Roblyer, 2004; and Smaldino, Russell, Heinich, & Molenda, 2005) that discussed methods and activities in the context of learning outcome categories. The researcher mapped the connections between the learning outcome types and methods identified in the literature for web-based learning.

The design for the first alpha script evolved from the detailed outline. One of the first steps in the design of ORSIDS, essentially a complex job aid, was the development of a graphic organizer to make distinctions between the different types of actions to be performed by the instructional designer in the process of delivering the script. The researcher did this through color coding including:

- Blue text for instructions to the Instructional Designer
- Purple text for directions from the Instructional Designer to the Faculty Member
- Green text for Instructional Designer questions for the Faculty Member

Findings from this design stage include the fact that a solid list of requirements greatly simplifies the task of developing a content outline. Another finding was that developing an appropriate form for a unique type of job aid is a major design challenge, particularly one which had to clearly convey so much complex content.

Product Development Phase

Development of the Alpha Version of the Product. In this phase, the first draft of the script was written. This task was based on the design decisions and the detailed outline developed in the design phase. Literature and other resources were consulted as needed. For example, to develop the demo, the researcher listed the web-based methods and multimedia features that needed to be illustrated and then searched within repositories and media-rich websites for multimedia applications to illustrate those methods and multimedia features.

For most topics, the supplementary resources were developed first and then the development of the script followed. The alpha version of the script that resulted was 33 pages of solid, undifferentiated text except for the supplementary resources that appeared for the most part in table form. This first alpha version was color coded as previously described. It was divided into two sections, Background and Script, and Background was the first section. The demo of websites with multimedia was presented in table form; its headings were “URL”, “Title”, “Media and Method Represented”, and “Notes”. This alpha version of the script provided input to the first round of formative evaluation.

Prerequisite Training for Faculty Subjects. Prerequisite training was provided to the three out of four Faculty Members who were not knowledgeable about learner analysis and defining learning outcomes, tasks that needed to be accomplished as prerequisites to the ORSIDS process. The lesson plan outline and other training materials are located in Appendix R. Two sections of this training were delivered in order to accommodate the schedule of one of the subjects, one of whom was not available to attend the first scheduled session with the other two subjects. The training with two people was much better received than the session with only one.

While the class with one person was successful in meeting the class objectives of conducting a learner analysis and refining learning outcomes, the subject did not express much enthusiasm for the course material. The class with two people, however, was received with a great deal of enthusiasm and lively participation. The subjects expressed their positive opinion of conducting the learner analysis. Despite the fact that these subjects were both seasoned instructors, they had never assessed their learners in this way and found it to be of enormous value.

Defining the learning outcomes was a bit of a challenge in the two-person training session. One of the subjects was a humanities professor, the other the instructor of a systematic methodology for reading instruction. Determining the learning outcomes for the skill-based class was less challenging than defining them for the broader humanities course.

The major finding from the training sessions was the value of teaching the analysis phase of instructional design methodology to all instructors, whether or not they are putting their courses online. Another finding was that this type of training is also probably better conducted in groups where participants can learn from each other's examples. Also of interest was how challenging stating learning objectives was for both of the humanities-related courses in the study.

Alpha Version Usability Field Testing: Cycles One and Two. The first field test was conducted by the researcher with a Faculty Member inexperienced with online teaching and instructional design concepts, including media selection, although she had delivered a technology-based course via video conference. The session was successful in that as a result of the process the Faculty Member generated numerous new ideas for the integration of online resources into her course. Additionally the session resulted in the identification of several good online resources, ideas for strategies with which to implement them, and additional URLs to search for more resources. At the end of the meeting, the subject voiced that she had had a very positive experience and now felt confident about searching for and integrating online resources where in the past she had not used them because searching took so long and the results were disappointing.

The process was successful in causing the Faculty Member to have new insights about how technology could be used to enhance her class. These Faculty Member insights can be classified as learner invention; they can be classified as the “synthesis” category of human thinking skills in Bloom’s taxonomy (1956). During the session, particularly during the discussion of methods, the Faculty Member spontaneously came up with a number of ideas for online resources that would enhance her curriculum. By the time the methods step of the script had been reached, the Faculty Member began to reflect on what she does now in the face-to-face situation and how technology-based resources could add to it. Some of the online resources she conceptualized and hoped to find were actually discovered during the search process. Additionally, it became apparent that one of the resources shown in the demo, the Virtual Piano, was very effective at conveying potential cognitive load problems. The subject viewed it and discussed experiences she had had with technology-based resources in the past that were problematic in terms of cognitive load.

The session also revealed problems. A major problem in this testing session was the lack of specificity of the subject's learning outcomes. While the Faculty Subjects had been provided with training on learner analysis and developing learning outcomes, this first Faculty Member had changed topics between the training and the testing session and brought a syllabus with numerous wide-ranging, nonspecific learning outcomes. While the issue was worked around and the session had a positive outcome, the lack of specificity of the learning outcome proved problematic throughout the testing session. Because of this problem, several major needs for the successful execution of this process came more into focus: the critical necessity for the Instructional Designer to be familiar with the course topic and to check the specificity and granularity of the learning objectives prior to the meeting. This problem also highlighted the difficulty of writing specific learning outcomes for this Humanities course.

The testing session also identified ways in which the script was hard for an Instructional Designer to use. The demo was not well enough structured. It identified online resources and some of their most important features but was loose in terms of identifying the process with which they should be demonstrated. The researcher made the mistake of using this demonstration time as an opportunity to search for resources of potential use to the subject, responding to her questions with searching. Some good resources were identified as a result of this process, but this step became quite time consuming and was not executed as dictated by the validated requirement. It became apparent that this portion of the script needed to be better scripted, leaving less room for improvisation on the part of the administering Instructional Designer.

Many other problems with the usability of the script's format made its use problematic for the researcher and required subsequent revision. For example, the print was too small to be easily read. Additionally the color coding was not effective as a graphic organizer; when using the script, the researcher forgot what the colors meant. The researcher also got confused about the order of some steps, and it became clear that everything needed for the Instructional Designer to successfully execute the script was not in one place. Some of the materials that had seemed supplementary were needed for the successful execution of the process and had to be moved into the script itself. The placement of the materials had to be better thought out, and the script had to be reorganized.

The researcher also found some of the script language stilted and not conducive to the collaborative conversation necessary between Instructional Designer and Faculty Member. In many sections she found herself not using the script verbatim but using it as a jumping- off point for dialogue with the Faculty Member. She wasn't sure how to resolve this issue because it seemed there was a need for a structured script for instructional designers without a great deal of content knowledge. The solution put in place was to add verbiage indicating that it was fine to use the script as a jumping-off-point rather than as written.

Because the researcher did not find the color coding to be helpful when actually delivering the script, but a graphic organizer was still needed, the script was transformed to a literal play script format with interactions on the left and words on the right, in an attempt to more successfully accomplish the desired functions. Additionally in the first alpha script, explanatory background material was placed before the script itself in order to make the material to be read first available to the reader first. However, this placement made it hard to access the script for use in the session with the Faculty Member. A decision was made to reverse the placement of these two sections but to indicate prominently on the Table of Contents that the Background Material should be read first. Additional changes made to the script as a result of this field test included the following:

- Specifying that the input issues related to context be resolved in an earlier meeting
- Amplifying the explanation of cognitive learning type
- Reversing steps 5 and 6 to introduce the concept of media before actually showing the media

As a result of the first test, the script was revised, and the result was a second alpha version of the script. The Alpha 2 script was 55 pages, and there were two sections, a script and background materials with the script placed before the background materials. The color scheme was eliminated; it was replaced in the script with two columns in actual play script format: the left hand side was labeled "Interaction Details" and the right hand side was labeled "What is Said". The script grew in length at least partially because of duplication between the background materials and the information in the left hand side of the script. Alpha Script 2 served as input for the second round of field testing.

The second field test was conducted by the researcher with a Faculty Member experienced with online teaching as well as instructional design concepts including media selection, but unfamiliar with media selection for the online environment. Despite the fact that this Faculty Member was experienced with instructional design and media selection, this process caused him to define his learning objectives much more explicitly and in general to think more deeply about his curriculum.

A major problem in the second testing session resulted from the fact that the testing occurred at the Faculty Member's office rather than in the office of the researcher. Resources that were available on the researcher's computer including software plug-ins and URLS for the demo and search session were not available on that of the Faculty Member. The researcher anticipated the lack of availability of the URLs prior to the session and compensated for this through adding a process to the script. However, the lack of the plug-ins that impeded the demo was not anticipated, and a process was added to deal with sessions when the instructional designer would be visiting the faculty member in his or her office.

Additional problems with the format of the refined script were also identified in this field testing session. The Task Analysis step had been recommended by the Expert Panel to replace the term "conditions of learning" which the panel found confusing. However, Task Analysis is a comprehensive multi-step process, and focusing it properly proved difficult, making it hard to script.

Much of the session was generated as a result of the researcher's independent judgment augmenting what was in the script. This was particularly true of the searching step which is quite improvisatory in nature. The searching process was more difficult this time than it had been in the first field test. Appropriate repositories for searching were not as readily apparent. The researcher and Faculty Member did quite a bit of brainstorming to identify potentially fertile search terms, search engines, and repositories.

Resources were discovered that the Faculty Member could make use of in his online class. However, during the session, the Faculty Member came up with an idea for exactly what he wanted, but this resource was not found online through the searching process. The researcher pointed out that since the Faculty Member's home institution has development funds, such a resource could potentially be developed. This idea was appealing to the Faculty Member.

In the process of using the script to work with the Faculty Member, the researcher found that many decisions needed to be tracked. This led to the decision to develop a form on which the various decisions arrived at in the testing session could be recorded, the ORSIDS Decision Tracking Form (page 2 of the Final ORSIDS Script in Appendix K).

The major findings from this session included the value of instructional design consulting even for faculty familiar with instructional design methodology, the changes in the ORSIDS process that need to occur when the session takes place at a faculty member's computer rather than the instructional designer's computer, and the need for additional format and design changes in the script. The individualistic and improvisatory nature of the searching was another finding.

The changes made to the script as a result of this field test included a clarification of the task analysis step and an added direction to keep track of, and provide to the faculty member, the URLs discovered in the search process. Another one of the changes was to shift the placement of the discussion of cognitive load from the evaluation step to immediately after the demonstration of one of the learning objects (the Virtual Piano, see page 237 of the script) to provide an example of what might be excessive cognitive load under some circumstances. This decision was made because this subject was reluctant to engage in this conversation during the evaluation phase late in the process. The researcher thought faculty members might be more receptive to the conversation if it occurred earlier. These changes resulted in what was supposed to be the Beta version of the script but that actually became the Alpha 3 version as a result of changes made to it in the Instructional Designer Training.

Prerequisite Training for Instructional Designer Subjects. The Instructional Designers were provided with training prior to participating in the testing sessions (see Appendix S). It primarily consisted of modeling script use and associated discussion. In order to make minimal demands on the subjects' time, the training was limited to four hours.

The Instructional Designers were provided with what was supposed to be the beta script to review prior to the training session. This script was 62 pages long and had the addition of a note on the first page with the Table of Contents telling readers to read the Background Information (which was placed second) first. One of the designers made a suggestion to align the headings of two of the charts, the Table of Learning Types and the Media Most Commonly Used for Them and the Multimedia Heuristic Guide, for the sake of consistency leading to greater usability. The script was re-designated the third alpha version, and this revision was made, resulting in the first beta version of the script.

Pilot Testing of the Beta Version. The Beta version of the script was 61 pages. In the pilot study the Instructional Designers used the script with one Online Instructor each to assist in selecting online resources for a real or potential course. Each pilot test took place in one 3 - 4 hour session. These sessions were observed by the researcher using

Nonparticipant, Naturalistic Observation. The researcher used an Observation Checklist (Appendix G) to record observations against the criteria and also videotaped and audiotaped the sessions for backup.

Both testing sessions resulted in positive outcomes in relation to the three problems within the scope of the study. Faculty increased their knowledge and confidence, and in some cases shifted lukewarm attitudes to much more positive, in relation to online pedagogy and their ability to adopt and evaluate online resources. Instructional Designers were provided with a process that not only allowed them to achieve some success in teaching instructional design methodology but also to assist educators in adopting online resources in a short period of time. Each testing session resulted in one or more online resources that were useful to the Faculty Member. But every testing session also included a number of process execution errors on the part of the Instructional Designer Testing Subjects that could be attributed to lack of instructional designer content knowledge and/or flaws in the design or formatting of the ORSIDS process and script.

Using the *ORSIDS Observation Recording Form* (Appendix I*)*, the researcher evaluated each session on the basis of elements of the Instructional Designer delivery of the script and the response of the learner. Prior to assessing the overall quality of the session and making recommendations for revisions to the script, the researcher evaluated each step of the ORSIDS process as administered by the Instructional Designer:

- **Introduction:** Both Instructional Designer Subjects executed this step skillfully. Both improvised from the script and did not use it verbatim.

- **Step 1: Which learning outcomes are good candidates? –** Instructional Designer Subject 1 was able to execute this step skillfully. She clearly delivered the information and was able to clarify misunderstandings. The Faculty Member learner appeared to be stimulated by the interaction and spontaneously arrived at a new technology-based curriculum idea.

  Instructional Designer Subject 2 executed this step less skillfully. While she asked the scripted questions for this step, she did not demonstrate the skill necessary to connect the scripted questions with the Faculty Member's candidate learning outcomes.
- **Step 2**: **Guide the task analysis –**The script did not enable either Instructional Designer Subject to execute this step skillfully. Instructional Designer Subject 1 skipped this step. In the Cognitive Walkthrough she revealed that she thought that this step had already been done and had questions about the meaning of the terms "instructional attributes" and "physical attributes". In the session facilitated by Instructional Designer Subject 2, the task analysis strayed from the learning outcome under consideration. While this process helped the Faculty Member working with Instructional Designer Subject 2 to generate additional ideas, it did not fulfill the purpose of the step in terms of thoroughly exploring the given learning outcome.
- **Step 3: Choose learning outcome category –** Both Instructional Designer Subjects successfully achieved the goal of this step to varying degrees. Instructional Designer Subject 1 executed the step as scripted. The Instructional Designer was successful in guiding the Faculty Member through the process of

choosing the learning outcome category, and the Faculty Member did the task correctly and appeared interested and engaged. Instructional Designer Subject 2 departed from the script and did not explain all of the learning outcome types; however, the Faculty Member she worked with did successfully identify the attitudes and verbal categories that applied to her learning outcome. Some of the script terminology including “cognitive strategy” and “abstract” vs. “concrete” concepts was confusing to both Instructional Designers.

- **Step 4. Choose instructional methods –** Instructional Designer Subject 1 executed this step skillfully. She accurately delivered the script and additionally used independent judgment where necessary to focus the Faculty Member. In this session, the Faculty Member expressed some creative curriculum ideas. Instructional Designer Subject 2 did not execute this step as skillfully. She omitted much of the script content for this step. In the cognitive walkthrough she explained that the reason for the omissions was because she thought that the Faculty Member Subject was already familiar with the material.
- **Step 5: Select potential media formats –** Instructional Designer Subject 1 skillfully contextualized and provided transitions in this part of the script. The Faculty Member that she was working with had a number of creative curriculum ideas. The Multimedia Heuristic proved difficult for this Instructional Designer Subject to work with. She attempted to cover everything in the Heuristic rather than just discussing the relevant portions that related to the methods identified in the previous step. Use of the Multimedia Heuristic was problematic for Instructional Designer Subject 2 as well. This Subject asked the Faculty Member

whether she thought the mentioned media might be useful for her purposes without connecting the media in the Heuristic to the methods identified in the previous step. This discussion did prove effective in causing the Faculty Member to discuss some potentially useful media assets.

- **Step 6: Provide a lecture/demonstration -** Instructional Designer Subject 1 skillfully conducted the demo overall. The Instructional Designer and the Faculty Member seemed to really enjoy this part, and the Faculty Member articulated some good ideas for curriculum in response. Instructional Designer Subject 1 appeared to find one section of the demo confusing. Instructional Designer Subject 2 did not do the demo as scripted, omitting parts of the demo that were necessary to illustrate critical concepts. In the cognitive walkthrough she stated that she omitted these sections because she thought that the content might be too juvenile for the Faculty Member. The Faculty Member that she was working with did bring up some of her concerns including issues related to affective learning and the importance of teaching students to process visual material.
- **Discuss cognitive load and message design issues –** This discussion was placed here because the Subject in the previous pilot test was clearly impatient with it when it was delivered in the evaluation phase. The researcher thought that if the step were moved, perhaps it would work better. This step proved to be out of place here. Instructional Designer Subject 1 discussed it in relation to the wrong application, and Instructional Designer Subject 2 skipped the step because there was a technical problem with showing the application that exemplified the concept.

- **Step 7: Search –** Both Instructional Designer Subjects conducted their searches in a somewhat improvisational and individualistic manner. Neither followed all of the directives of the script, but both were successful in helping the Faculty Member to find one or more useful online resources and to create plans for further fruitful searching. Instructional Designer Subject 2 bypassed many of the listed repositories and omitted the use of the suggested keywords to look for specific media-related resources. She also omitted a critical step, that of keeping a list of the discovered online resources to give to the Faculty Member. She did, however, compensate for the earlier flawed execution of the task analysis step with a preliminary discussion that she guided here.

  The searching of Instructional Designer Subject 1 reflected the fact that she had not been sufficiently prepared with information about the use of online multimedia assets. This subject demonstrated a lack of knowledge about qualities of online resources that could make them useful (for example, that a source did not have to standalone completely but could be scaffolded with explanatory textual material developed by a faculty member). This lack of knowledge caused her to discount the value of useful resources that her team did find. She also was not sufficiently prepared to integrate the Faculty Member's earlier creative ideas into the search process that she guided. This subject did, however, demonstrate the ability to meet some of the goals of this step. In addition to finding several resources, this dyad came up with a plan for further searching.

- **Intro to evaluation and evaluation steps**

  Since Instructional Designer Subject 1 was dissatisfied with the online resources that she and the Faculty Member did discover, she led the Faculty Member in a process to evaluate imaginary online resources that would be discovered if their searching plan was successful. Instructional Designer Subject 2 fulfilled the evaluation steps correctly except that she did not reference the Multimedia Heuristic when checking **Criteria 8. "Compatible with *Multimedia Attribute Heuristic Guide?"*** Also this team fulfilled **Criteria 1, "Does the resource fulfill learning needs from the task analysis?",** but not in the proscribed way. Instructional Designer Subject 2 did not initially lead the task analysis as delineated in the script but compensated by doing the needed steps intuitively prior to embarking upon the searching process. Both Instructional Designer Subjects had questions about the meaning of the term "instructional and physical attributes".

Post Pilot Test Learner Validation. After each pilot testing session, the researcher and Instructional Designer debriefed the session. In the debriefings with the Instructional Designers that followed the testing sessions, they expressed positive attitudes towards the process. Both agreed that the script made it far easier to teach instructional design skills and to accomplish the task of finding online resources than they could on their own. Instructional Designer Subject 1 stated that the application is a great tool with many applications that is hugely practical, provides a straightforward process, and equalizes the playing field between instructional designers with a lot of knowledge and those without it. The subject reported that she walked away from the testing with new information that will contribute to her expertise and change her instructional design practice in a positive manner. Instructional Designer Subject 2 stated that ORSIDS was very enlightening, comprehensive, and that it was good to have a guide in order to be reminded of instructional design features.

However, both test subjects reported some problems with the usability, format, and content of the script. Instructional Designer Subject 1 felt the need for more at-a-glance support in terms of the format of the script. She suggested eliminating text in the script and replacing it with keywords where possible. Instructional Designer Subject 1 also felt that the search step should be expanded to include more repositories. She disagreed with the evaluation requirements established by the Expert Panel and felt that the evaluation step should define success in broader ways, for example with criteria including whether the Faculty Member knows how to evaluate a site and/or has a search plan. She also stated that some of the language was too sophisticated for the context and that sentences were too long. She recommended that the “Multimedia Heuristic” be retitled “Learning Media Matrix”. Both subjects recommended that the terms “instructional attributes” and “physical attributes” be better explained. Both subjects also recommended that the ORSIDS Tracking Form be transformed into more of a job aid with embedded process information.

Instructional Designer Subject 2 was generally quite positive about most aspects of the script although, like the first subject, she felt that there was too much information to absorb between the combined left and right hand sides of the script. This subject felt that some of the necessary context was missing in the early steps and that it was not clear that the learning outcome was being discussed in connection with online resources that would help students to achieve it. She was confused by the three-page Multimedia Heuristic and suggested putting different titles on the individual pages to clarify the differences in the contents on each page. She suggested the adoption of a process flow in the future for faculty member use.

A major factor affecting the performance of Instructional Designer Subject 2 was the interaction between herself and the Faculty Member with whom she was working. This subject revealed in the cognitive walkthrough that she skipped portions of the scripted content because of her perception that it wasn't appropriate for the subject with whom she was working, either because she guessed that the Faculty Member already knew it or feared that it might be too juvenile. She acknowledged that she may have skipped important content. She also stated that she should have taken more time to study the script content before participating in the pilot test.

To conclude, the pilot test findings included the following:

- While neither Instructional Designer Subject administered the process or delivered the script in a way that demonstrated mastery, the performance of Instructional Designer Subject 1 was more skillful than that of Instructional Designer Subject 2 who left out a good deal of content. This subject stated that her omissions resulted from her lack of familiarity with the script and her perception that some of the scripted content might not be appropriate for the Faculty Member with whom she was working.

  In both cases, the Instructional Designer Subjects were able to facilitate sessions resulting in successful searching for online resources, although in the case of Instructional Designer Subject 2 they were text based because of omission of the provided search terms for media assets. Learning on the level of synthesis (Bloom, 1956) related to technology-based course development was demonstrated by the Faculty Member Subject who worked with Instructional Designer Subject 1, the subject who delivered the script more accurately. This type of learning was not demonstrated by the Faculty Member Subject who worked with Instructional Designer Subject 2 although this Faculty Member did share some of her concerns about teaching online at the session and stated afterwards that the experience had been of value. There was insufficient data to identify the Bloom's Taxonomy level of learning for Faculty Member 2.

- The format of the script and related training were not sufficient to enable mastery of the script delivery on the part of either Instructional Designer Subject.

As a result of these pilot tests, the beta script was revised, and the final version resulted (see Appendix K). Revisions to the script and ORSIDS Tracking Form that occurred after the pilot testing hopefully alleviated many problems resulting from deficient formatting. Major features of this script included the following:

- The script was 63 pages long
- The *ORSIDS Tracking Form* was placed immediately after the *Table Of Contents* page
- The ORSIDS format was greatly modified to incorporate keywords on the left hand side of the script to supply more "at-a-glance" performance support. Detailed directions were removed and placed in the section on *Background Information and Supplementary Materials*.

- The Media section was revised to incorporate more information about media attributes. This revision was made in response to the fact that the performance of the Instructional Designers revealed that they didn't sufficiently understand the concepts of instructional and physical attributes of media and how online resources can be used to fulfill or partially fulfill learning outcomes. This was previously addressed in the Task Analysis section, but apparently not adequately. This added information was also intended to help with the administering of the Multimedia Heuristic which was also contained in this section.
- The headings of the Multimedia Heuristic Guide were revised to include information about what was contained on each page.
- The ORSIDS Decision Tracking Form was modified to include process keywords to transform it into a more supportive job aid.

Development of Summative Evaluation Materials. Several items were prepared to convey to the Expert Panel how the product had evolved. These items included the *Observation Report* (Appendix I) and *Abbreviated Validated Requirements and Their Implementation in ORSIDS* (Appendix J). These documents were created to communicate essential information about the document's evolution and the testing results to the Expert Panel while minimizing the amount of information that they had to absorb. Additionally a questionnaire (Appendix L) was prepared to gather panel members' assessments of how well the script fulfilled the validated requirements. An Expert Advisor reviewed the basic format of the questions.

Product Evaluation

The Expert Panelists rated the process script highly overall while acknowledging the need for further field testing and formatting changes. Expert Panelist 1 wrote: “In reviewing the ORSIDS script and contemplating feedback about the steps and processes, I believe a very effective model has been created to guide ID’ers through the process of assisting faculty with choosing appropriate, instructionally sound online resources.” Expert Panelist 2 wrote, “You did a really thorough job. Good stuff!” Expert Panelist 3 wrote, “Great job!....this is such a large initiative….I imagine that this will be very useful and help many!”

Part 1 of the questionnaire asked the panelists to rate the degree to which ORSIDS achieves the study goals of (1) enhancement of pedagogical skills of online faculty, (2) more effective use of college-employed instructional designers, and (3) educator adoption of online resources. A scale of 1-4 was provided, with 4 representing “it achieves it”, 3 “it achieves it but would benefit from minimal revision”, 2 “it partially achieves it but could use substantial revision”, and 1, “it does not achieve it”.

For the first question related to how well the script achieved the goal of “enhancement of pedagogical skills”, two of the panelists rated it at a 4 and one at a 3. Panelist 2, who rated it at a 3, wrote, “I have problems with the term ‘pedagogical skills’. When I hear this term I think of the actual online delivery, not the design skills. Perhaps you want to insert ‘design’ between ‘pedagogical’ and ‘skills’.” Panelist 4, who rated it at a 4 wrote, “The very fact that this process engages the faculty member in the stages and processes of ID supports the notion that ORSIDS enhances the pedagogical skills of online faculty.”

The second question related to how well the script achieved the goal of "more effective use of college employed instructional designers." All three panelists gave it the highest rating, a 4. Expert Panelist 1 wrote, "The ORSIDS tool works as an effective performance support tool for instructional designers, no matter their level of experience. ..many times such designers may have little or no training/education in ID, and so this guide could serve not only as an introduction, but also as a job aid to help them walk through the process with the faculty in a theoretically sound and user friendly manner." Expert Panelist 3 wrote, "Amazingly useful job aid!!!"

The third question asked how well the script achieved the goal of "educator adoption of online resources." Two of the panelists rated it at a 3 and one at a 4. Expert Panelist 1, who rated it at a 4 stated, "This tool serves to introduce faculty to instructional considerations for selecting resources, as well as demonstrating examples of different types of resources and teaching faculty how to go about locating appropriate resources for their own instruction." Expert Panelist 2, who rated it at a 3, stated: "This question was difficult to answer. A better question would be if it makes it more attractive or easier. After all, we cannot actually verify if the faculty member did use them or not in the end product." Expert Panelist 3, who rated it at a 3, stated: "I think this will help greatly…some additional variables will still be needed to accomplish full and successful adoption."

Part II, which constituted the major portion of the questionnaire, asked the panelists to rate how well the script fulfilled the validated requirements. See *The Abbreviated Validated Requirements and Their Implementation in ORSIDS* (Appendix L) for a description of the requirements and how they were classified.

Questionnaire Section IIA asked the panelists to rate how well Requirements 1 – 3, the input requirements, had been fulfilled in terms of lack of bias and content accuracy, appropriateness, and usability. All three panelists gave it the highest rating, a 4 out of 4, on all measures. Expert Panelist 1 wrote: ”Walking faculty through the process of analyzing their target audience and their instructional needs, their learning context, and the intended learning outcomes will help the faculty choose content that more accurately serves to address the needs of the learners and support the instructional objectives. The acknowledgement of context and learner characteristics will also help the faculty member choose content that learners will find easily usable and unbiased.”

Questionnaire Section IIB asked the panelists to rate how well Requirements 4 – 6, the input requirements, had been fulfilled in terms of lack of bias and content accuracy, appropriateness, and usability. Panelists 1 and 3 rated it at the highest rating, a 4, on all measures. Panelist 2 rated it as a 4 on accuracy and lack of bias but gave it a 2 for usability and appropriateness of content. This panelist felt that some faculty members would find this process cumbersome and would not appreciate being lectured at with so much information. She was not sure what to suggest as an alternative. (It should be mentioned that it was for these same requirements that Instructional Designer Subject 2 omitted portions of the script, obviously sensing the type of reaction on the part of the Faculty Member that Expert Panelist 2 anticipated. It should also be noted that these same sections were those that resulted in the greatest number of technology-based curriculum related ideas on Bloom’s level of synthesis on the part of the three out of the four Faculty Member Subjects who expressed them.)

Questionnaire Section IIC asked the panelists to rate how well Requirements 7 – 10, the Research and Gather Online Resource requirements, had been fulfilled. All three panelists rated it at a 4 out of 4 on all measures. Expert Panelist 2 wrote, “In Step 7, it may be more appropriate to ask the Faculty Member which methods he/she uses in the f2f environment. One question I like to address is ‘how do you transfer the methods and strategies to the online environment?’” The same panelist commended the tables and cognitive load guidelines as “excellent resources!”

Questionnaire Section IID asked the panelists to rate how well Requirements 11 – 21, the Research and Gather Online Resource requirements, had been fulfilled. All three Expert Panelists rated it at a 4 out of 4 on the measures of lack of bias and content accuracy, appropriateness, and usability.

Expert Panelist 1 indicated that to streamline the ORSIDS process, two of the requirements, 18 and 19, could be eliminated. Requirement 18 is “whether the resource is compatible with Mayer’s as well as Fleming and Levie’s principles for instructional message design.” Requirement 19 is “whether the resource is compatible with findings related to media attributes including some of the more recent empirical findings regarding multimedia attributes.” This panelist stated that Requirements 11, 12 and 14 were the most significant requirements of this group. Requirement 11 is “Whether the resource can fulfill the learning outcome task analysis requirements.” Requirement #12 is “Whether the resource has the appropriate instructional and physical attributes.”, and Requirement 14 is “Whether the resource is appropriate for the learner”. The panelist wrote: “I think if there were any room for streamlining the selection process, perhaps it could occur here. Numbers 18 and 19, although important, may be addressed by the fact that the designer has guided the faculty member through the ID process in a systematic way, based on empirically-tested ID theory – if conditions 11, 12 and 14 are addressed, these seem to me to be the most critical of this set of requirements."

Questionnaire Section IIE asked the panelists to rate how well Requirement 22, the output requirement, was fulfilled on the basis of lack of bias and content accuracy, appropriateness, and usability. Expert Panelists 2 and 3 rated it at all 4's. Expert Panelist 1 revealed a miscommunication about the meaning of the requirement. This panelist did not rate it but wrote, "since this is the actual act of choosing the online materials, I'm hesitant to evaluate it per se….I think the efficacy and appropriateness of the materials is likely influenced by the analytical activities identified previously."

Questionnaire Section IIF asked the panelists to rate how well Requirements 23-26, the format requirements, had been fulfilled on the basis of human factors: how efficient the script was to use, how subjectively pleasing, and how easy it was to learn and remember. Expert Panelist 1 rated it at a 4 for ease of learning and subjective pleasingness and a 3 for efficiency and ease of remembering. This panelist wrote, "The structured nature of the ORSIDS will facilitate learning the process of media selection from it. However, its length may make it difficult to remember and may pose some time challenges for users (both ID'ers and faculty)". Expert Panelist 2 rated it at all 4s on these requirements except for "easy to remember", which this panelist rated at a 3. About Requirement 24, "It can be copied and used for each new instructional designer/online faculty member online resource selection interaction", this panelist wrote: "I expect some flexibility here". Expert Panelist 3 rated all of the format requirements at the highest rating, a 4 out of 4.

Questionnaire Section IIG asked the panelists to rate how well Requirements 27-32, the Reference Materials Requirements, had been fulfilled. All three panelists gave the highest ratings to the lack of bias and content accuracy, appropriateness and usability implemented by the script reference materials. Expert Panelist 1 stated: “Revisions to these tools based on pilot testing feedback will help make these important supplements to the process more usable and effective.”

Questionnaire Section III asked the Expert Panelists whether they agreed or disagreed with the original validated requirements, and whether they would add to or subtract any of them. Expert Panelists 2 and 3 stated that they agreed with the original requirements. Expert Panelist 1 wrote, “I still agree with the steps we came up with, but as your pilot tests suggest, perhaps some general streamlining is possible. I think the way you have modified the supplemental materials will make them easier to use (still think they are necessary job aids, particularly because the content of each is far too much for any human to remember).”

The last portions of the questionnaire asked for general feedback and suggestions to improve ORSIDS. Expert Panelist 2 made several suggestions for improvements:

> “It may be advantageous to include a visual such as a flowchart outlining the process (steps) for the FMs (faculty members). This practice relates back to individualization of training and learning styles. I would appreciate a flowchart to look at while going through the process with the FM.”

This panelist also stated:

> “It was not surprising to me that the ID did not read the script verbatim. I find the script to be too long and somewhat imposing (top-down approach). I know several

FM who would have a problem with this (I provide professional development to faculty on campus)."

Panelist 1 pointed out some aspects of the questionnaire that she found confusing. "In some cases in my final review, I struggled with not the steps or the process so much, but the evaluation choices regarding the script steps and process."

Panelist 1 and 3 gave positive feedback on the project as a whole. Expert Panelist 1 wrote, "You have done an excellent job creating a tool for a definite need in higher education." Expert Panelist 3 concluded, "You have really done a thorough job here…I am honored to have had a chance to work on this project."

Summary of Results

A process script was developed iteratively through successive cycles of formative evaluation. It underwent two rounds of field testing by the researcher to help to improve the design of the process and format of the script. The script format was discovered to be in need of much revision, but its use resulted in the discovery of valuable online multimedia resources. These sessions also resulted in much creative thought on the part of both Faculty Subjects related to using technology in the curriculum on the level of the Bloom's taxonomy (1956) "synthesis" level.

Next the process script underwent two rounds of pilot testing administered by two different Instructional Designer Subjects. Neither subject was adequately prepared to administer the script with mastery, but one subject was much more skillful in adhering to the script and communicating the basic instructional design processes. The Faculty Subject who participated in the more fully realized testing session demonstrated creative thought related to using technology in the curriculum on the level of the Bloom taxonomy "synthesis" level while the Faculty Member participating in the less well-realized session did not demonstrate similar creative thought. This creative thought was primarily displayed in the sections of the script related to the Learning Outcome Analysis Requirements. While neither search sections resulted in all of the project goals, useful online resources were discovered in both sessions.

In the cognitive walk throughs that took place after the testing sessions, the Instructional Designer Subjects expressed positive impressions of the process and script. They also expressed the need for additional content knowledge and changes in the format script to make it a more accessible job aid. Many of these changes were made in the next version that was sent to the Expert Panel for summative evaluation. The Expert Panel rated the script highly overall while acknowledging the need for further script format revisions, further pilot testing, revisions to the summative evaluation questionnaire, and streamlining of the ORSIDS process.

Chapter 5

Conclusion, Implications, Recommendations, and Summary

Conclusion

In online classes, where courses are delivered via computer, online resource selection and the associated issues of media selection and instructional message design take on great importance. Important work has been done in the past by prominent instructional design theorists in developing media selection processes and models and understanding media attributes. Because there was not the same critical need for these findings prior to the advent of online learning, the results were not widely adopted, and the work was set aside. Now there is a pressing need for such guidance for multimedia selection activities for online classes. Large numbers of educators unschooled in instructional design are being tasked with developing online classes. Online courses have the potential for utilizing many multimedia options (Criticos, 1996) and online resources, and improper implementation of multimedia can negatively affect learning (Clark & Mayer, 2002).

Instructional designers are increasingly being hired to assist faculty with online course design, but all of the necessary processes and documentation are not in place to support them in their challenging role of change agents responsible for diffusing technology-based techniques and strategies into the educational practice of face-to-face instructors. Various organizations have invested considerable resources in digital media repositories, but they are underutilized because of lack of faculty knowledge and skill in their use.

This study has endeavored to address these problems through developing a process script for collaborative work between instructional designers and faculty members to search for and evaluate online resources. The theory behind the product that was developed, ORSIDS, resulted from the synthesis of the important past work of various instructional design scholars in media selection and current work in educational psychology related to multimedia and cognitive load. There is now a critical need for developing and researching technology-related applications that work in real instructional situations (Roblyer & Knezet, 2003). ORSIDS is an example of a successful, though not yet completely realized, endeavor to create one such application.

This study set out to answer six research questions. The questions, and the answers that resulted from the study, are discussed as follows.

Research Question 1. What steps are necessary to develop a process script that will help instructional designers guide online faculty in selecting online resources for their online classes?

While further iterative testing and revision will be necessary to develop a high-quality final ORSIDS product, the steps that are necessary to develop the process script described above were basically those utilized by this study with some enhancements.

- Do an extensive literature review, and interview one or more experts to gather input to formulate candidate requirements.
- Validate the candidate requirements with a knowledgeable and committed Expert Panel.

- Design and develop an alpha script based on the validated requirements utilizing an experienced individual’s instructional design skills and consulting additional literature as necessary.
- Provide the necessary training to two types of subjects, online faculty members and instructional designers, to enable them to use the script.
    - The training for the Faculty Members should cover the analysis phase of the instructional design process and ideally be delivered to a group of two or more. While based on a small sample, this conclusion is based on the fact that the training with two people was much better received than the session with only one. It seems likely that the class with two people was more successful because of the interaction made possible by the ability to learn from each other’s examples.
    - The training for the Instructional Designers should cover all aspects of the ORSIDS process, concentrating particularly on areas that may be lacking in the subjects’ educational and/or experiential background. Prior to receiving the training, the subjects should have thoroughly read the material. The Instructional Designer Subjects should be assessed as to their knowledge of basic ORSIDS concepts and should exhibit a level of mastery prior to engaging in testing. Compensate the Instructional Designers if at all possible for 15 hours’ worth of time to cover the time for

training, testing, and thorough reading of the script in preparation for training and testing.

- Do two rounds of usability testing with Online Faculty Members and the researcher to discover the most basic script flaws and deficits and make necessary revisions.
- Gather input from the Instructional Designers on improvements they would make to the script and make revisions prior to testing.
- Observe two rounds of pilot testing between Instructional Designer and Online Faculty Member – as well as participating in cognitive walkthroughs with each Instructional Designer - to gather more data on script usability, and make revisions as indicated.
- Continue to iteratively revise and test the process script until no further flaws related to the script are revealed during testing.
- Develop a summative questionnaire and other materials enabling the Expert Panel to do a rigorous summative review. Pilot test the questionnaire.
- If possible, hold an in-person summative review with the Expert Panel.
- As appropriate, make further changes suggested in the summative review.

While the process script achieved the stated research question objective of being helpful to the Instructional Designer, more testing is needed to know whether the final script submitted for summative evaluation is capable of resulting in process mastery. The script and related training will continually need to be tested and revised until flaws in delivery that can be attributed to ORSIDS no longer exist. This was the process followed in developing the Resier Gagne (Reiser & Gagne, 1983) media selection model. Additionally the Summative Evaluation Questionnaire must be revised and thoroughly pilot tested prior to the next round of use.

The variations in the performance of the Instructional Designers, and the differences in the kind of errors the two made, provided evidence that there are a number of variables in Instructional Designer preparedness and the Instructional Designer/Faculty working situation that can affect the effectiveness of the delivery of ORSIDS beyond the script itself. Some of these factors include the content knowledge, diligence, judgment and skill of the Instructional Designer, the receptivity of the Faculty member, and the group dynamics of the dyad.

Research Question 2. What requirements must that script satisfy in order to be considered successful?

Face validation during the testing process and recommendations resulting from the Expert Panel Summative Evaluation resulted in some changes to the initially identified requirements. It was concluded that the requirements should basically be the requirements initially validated by the Expert Panel with the following exceptions (see Chapters 3 and 4 for further details).

Requirement 5, Do a task analysis for the specified learning outcome, proved challenging for the subjects to execute. The process of Task Analysis requires independent judgment and cannot really be “scripted”. Task analysis is a very complex task that in future versions should be streamlined to target the candidate requirement that it replaced: “the conditions of learning that the resource must be capable of fulfilling.”

Requirement 19, Whether the resource is compatible with findings related to media attributes including some of the more recent empirical findings regarding multimedia attributes. The researcher found that it is not appropriate to fully implement this requirement because users cannot absorb all of the information in combination with the rest of the process and implemented it only quite generally in the *Multimedia Heuristic Guide*. Expert Panel Member 1 stated that this requirement could be eliminated entirely to streamline the ORSIDS process..

Requirement 23, The script will consist of text on paper and will include a decision tree. It will be supplemented by demonstrations on the computer for the faculty member by the Instructional Designer. The script does consist of text on a paper and a computer demo, but there is no decision tree. As the process was developed, the researcher discovered that there were no decisions resulting in just one choice. Most involved a number of options and could not be precisely delineated as required by a decision tree. The *ORSIDS Decision Tracking Form* was created, and tables were developed (the *Table of Learning Types and the Methods Most Commonly Used for Them*, the *Table of Learning Types and the Media Most Commonly Used for Them*, and the *Multimedia Heuristic Guide*) to present the many options. The next version of ORSIDS will also contain a process flow rather than a decision tree, suggested both by Expert Panel Member 2 and by Instructional Designer Subject 2.

Requirement 28, A Cognitive Load and Instructional Message Design Text Job Aid. These guidelines were limited to a small selection of Mayer's and Fleming and Levie's principles. The researcher found that sitting through this explanation was hard for people after going through this extensive process, particularly when their chosen resource didn't have any complex instructional message design issues. Expert Panel Member 1 agreed that this requirement could be made optional.

Expert Panel Member 1 stated that many evaluation requirements could be eliminated to streamline the ORSIDS process. Of the following learning resource evaluation requirements, this panelist suggested that only 11, 12 and 14 might be necessary.

Requirement #11	*Whether the resource can fulfill the learning outcome task analysis requirements*
Requirement #12	*Whether the resource has the appropriate instructional and physical attributes*
Requirement #13	*Whether, if applicable, the resource accepts student input in a manner that appropriately demonstrates his or her knowledge*
Requirement #14	*Whether the resource is appropriate for the learner*
Requirement #15	*Whether the resource is credible.*
Requirement #16	*Whether the resource will have longevity as a link on the web or a request needs to be made to download it onto a server.*
Requirement #17	*Whether the resource places an acceptable amount of cognitive load on the learner.*
Requirement #18	*Whether the resource is compatible with Mayer's as well as Fleming and Levie's principles for instructional message design.*
Requirement #19	*Whether the resource is compatible with findings related to media attributes including some of the more recent empirical findings regarding multimedia attributes.*
Requirement #20	*Is the online resource affordable?*
Requirement #21	*If there is a choice among resources, has the need to accommodate various learning styles been acknowledged with selection of the resource that will add the most diversity to the instruction?*

As a result of what has been observed in the testing process, the researcher agrees that except for Requirements 11, 12 and 14, these requirements are not necessary for every case and may only apply to specific situations. These requirements were not applicable to most of the field and pilot test sessions. In the next version of ORSIDS, these learning resource evaluation requirements will be made optional, for use only in circumstances where a need for them is indicated.

Research Question 3. What will be a functional format and composition to enable the script to meet the specified requirements?

This is the research question that has not yet been completely answered. Fulfilling this requirement has proven to be the greatest challenge. ORSIDS has undergone many changes to achieve this requirement, and would benefit from further testing. The literature reveals that reducing massive amounts of complex material to a simple and usable format is often a challenge (Resier & Gagne, 1983). Furthermore, the type of format that would work best for one type of user will not necessarily be best for everyone.

Research Question 4. How can a set of requirement candidates be established?

Requirement candidates were established through a literature review and expert interview written up in Chapters 3 and 4.

Research Question 5. How can the requirements be validated?

The requirements were validated through the requirements validation process written up in Chapters 3 and 4. These requirements were further validated through formative evaluation resulting from the field and pilot testing. The summative evaluation process was the final step in requirements validation.

Research Question 6. How can the process script be evaluated?

The process script was evaluated both formatively and summatively. These evaluations are described at length in Chapters 3 and 4. Summative evaluation consisted of evaluation of the final script by members of the Expert Panel. The Expert Panel members reviewed the script and additional materials about script development and filled in a questionnaire. Formative evaluation consisted of:

- Usability testing of the script by the researcher and two Faculty Members as well as
- Pilot testing of the script by two Instructional Designers with one Faculty Member each
    - The pilot tests were observed by the researcher
    - The pilot tests were followed by cognitive walkthroughs led by the researcher with the participating Instructional Designer

There is evidence that further formative evaluation is necessary. To create a high quality process script, iterative cycles of development and usability testing are necessary. These cycles must be continued until no further flaws are revealed in the product.

Summary of Findings

This study had several goals and two different groups of subjects. Consequently the findings can be divided into the answers to four basic questions in addition to the research questions that have been previously discussed:

1. Did the ORSIDS process that was developed prove capable of helping faculty to learn instructional design skills, assisting with their ability to integrate technology into their curricula?

2. Did the ORSIDS process script developed in this study assist instructional designers with their jobs as change agents, assisting faculty in integrating technology?
3. Was the script an appropriate job aid for assisting instructional designers in the delivery of this process training?
4. Does the ORDIDS process script have the potential to achieve the goal of educator adoption of online resources?

The answer to question 1, “Did the process that was developed prove capable of helping faculty to learn instructional design skills, assisting with their ability to integrate technology into their curricula?” can be answered in the affirmative based on the evaluation by the Expert Panel and the results from the field and pilot testing. Two of the three Expert Panel Members rated “the enhancement of pedagogical skills of online faculty” with a 4 out of 4, stating the ORSIDS achieves the goal of the enhancement of pedagogical skills of Online Faculty. One of these Expert Panelist Members wrote: “The very fact that this process engages the faculty member in the stages and processes of Instructional Design supports the notion that ORSIDS enhances the pedagogical skills of online faculty.” The Expert Panel Member who rated the attainment of this goal at a 3 out of 4 wrote, “It achieves it but would benefit from minimal revision”, explaining her rating by stating that she thinks of the term pedagogical skills to mean actual online delivery rather than design skills and felt the idea would be better communicated with the term “pedagogical design skills.” The field tests and pilot tests revealed that when the ORSIDS process was correctly communicated to the Faculty Members, the result was creative thought related to using technology in the curriculum on the level of the Bloom taxonomy “synthesis” level (Bloom, 1956).

As for question number 2, the study found that the process script has strong potential to assist instructional designers with their jobs. All three members of the Expert Panel gave ORSIDS the highest rating in its ability to achieve the goal of “more effective use of college-employed instructional designers”. One of the Expert Panel Members called it an “amazingly useful job aid!” Another Expert Panelist stated “The ORSIDS tool works as an effective performance support tool for instructional designers in higher education, no matter their level of experience……….many times such designers may have little to no training/education in Instructional Design, and so this guide could serve not only as an introduction, but also as a job aid to help them walk through the process with the faculty in a theoretically sound and user-friendly manner.” Both Instructional Designer Subjects rated the process highly. In the debriefings with the Instructional Designers that followed the testing sessions, they expressed positive attitudes towards the process. Both agreed that the script makes it far easier to teach instructional design skills and to accomplish the task of finding online resources than they could on their own.

Deficiencies reported by the Instructional Designer Subjects related to problems with script formatting (question 3) that were hopefully at least partially alleviated in the latest revision. Further usability testing will be necessary to know if this is so. It is very possible that several more iterations of the script will be necessary to make the format completely usable and user friendly. The product may have to stray even further away from the script format. One of the Instructional Designer Subjects critiqued the format, stating that it was hard to have a conversation with a script and that what was needed were more keywords and at-a-glance support. The researcher incorporated these suggestions into the last version of the script. However, one of the Expert Panelists stated upon evaluating the most recent version in her summative review:

> "It was not surprising to me that the instructional designer did not read the script verbatim. I find the script to be too long and somewhat imposing (top-down approach). I know several faculty members who would have a problem with this (I provide professional development to faculty on the campus)."

It is necessary to distinguish between the format of the script and the delivery of the process. For while the script format was consistently flawed during the testing to a greater or lesser extent, in three out of the four testing sessions, the process was disseminated relatively well to the Faculty Members. For example, because of the researcher's content knowledge, she was able to compensate for the script's lacks in her delivery of the process during the first field tests. These sessions resulted in much creative thought in the Faculty Subjects related to using technology in the curriculum on the level of the Bloom's taxonomy "synthesis" level (Bloom, 1956). Both field sessions also resulted in the discovery of valuable online multimedia resources. And while neither of the two Instructional Designer Subjects administered the script flawlessly, Instructional Designer Subject 1 was much more skillful than Instructional Designer Subject 2 in communicating the basic instructional design processes. Instructional Designer Subject 2 reported that she left out a number of portions of the script because of lack of familiarity with the content due to inadequate preparation and because of the perception that the content would not be well received by the Faculty Member.

The Faculty Member who worked with Instructional Designer Subject 1 demonstrated creative thought related to using technology in the curriculum on the level of the Bloom taxonomy "synthesis" level (Bloom, 1956). The Faculty Member who worked with Instructional Designer Subject 2 did not demonstrate this creative thought, although she did voice some of her concerns related to student processing of online resources. Thus it was demonstrated that the Instructional Designer Subject who most closely followed the specified process was much more successful in teaching the Faculty Member instructional design skills and stimulating technology-related creative thought processes.

The answer to Question 4, "Does the ORDIDS process script have the potential to achieve the goal of educator adoption of online resources?", must be qualified by the fact that other variables are involved in the attainment of this goal besides the quality of the script. Thus two of the Expert Panelists rated the achievement of the goal of "educator adoption of online resources" with a 3 out of 4. Stated one: "I think this will help greatly…some additional variables will still be needed to accomplish full and successful adoption." Stated the other, "This question was difficult to answer. A better question would be if it makes it more attractive or easier. After all, we cannot actually verify if the faculty member did use them or not in the end product." The third Expert Panelist who rated this goal as a 4 out of 4 stated, "This tool serves to introduce faculty to instructional considerations for selecting resources, as well as demonstrating examples of different types of resources and teaching faculty how to go about locating appropriate resources for their own instruction." Several of the Faculty Subjects in the field and pilot testing indicated that this experience would have a positive effect on their own practice and would make them more open to searching for online resources in the future.

In addition to the above four questions related to the attainment of project goals, all of which were answered in the affirmative, the study made a number of additional findings.

- The importance of specific and clearly stated learning outcomes was a significant finding of the study. The first testing session demonstrated the necessity of working with very clear and distinct learning outcomes for the process to be effective. As a result, the investigator revised the testing process to require that learning outcomes be approved prior to future testing sessions. The necessity for specific, granular and clearly stated learning outcomes is a well-established tenet of instructional design theory that this study once again validated.
- The study established the value of teaching instructional design methodology to faculty members in the context of the development of their own online courses, with such instruction clearly of benefit even for those with prior knowledge of instructional design methodology. The question arose whether it was the ORSIDS process itself, the act of sharing the thought process with another knowledgeable person or some combination of the two that made these thought processes possible.
- The study established the value of teaching the analysis phase of the instructional design process, and in particular learner analysis, to all faculty members, online and face-to-face. Additionally the study found that this type of training is probably more effective when done in groups rather than individually.

- The study found that developing an appropriate format for a unique job aid, particularly one with a great deal of complex content, is a major information design challenge. The ORSIDS process involved two kinds of activity: (1) directed and (2) based on individual judgment. The study found that the script needed to guide these two kinds of activities differently, and that a format needed to be created to guide both directed activity and activity based on individual judgment. Instructional designers at different levels of proficiency may have different needs for such direction. The question arises whether several ORSIDS scripts should be created with different formats reflecting varying needs for direction.
- The study found that instructional designers are excellent subjects for information usability projects because of the effective suggestions for format improvements that they are able to make
- The study found that issues of adoption and diffusion would have a major impact on the implementation of this process script, irrespective of its quality
- The study found that the training as implemented was not sufficient preparation for the Instructional Designer Subjects to master delivery of the ORSIDS script. It was apparent after observing the Instructional Designer Subjects' delivery of the script that the training in addition to the script format was probably in need of revision. Both Instructional Designers made content errors, indicating that they were not sufficiently prepared to deliver the script.
  - ✓ The search process administered by Instructional Designer Subject 1 would have been more successful if she had better understood the qualities

of online resources that make them useful so she could have accurately assessed the value of the resources that she and the Faculty Member she worked with did find.

- ✓ The search process administered by Instructional Designer Subject 2 would have been more successful if she had remembered to include the multimedia search terms and to track the discovered resources to provide to the Faculty Member at the conclusion of the session. Additionally Instructional Designer Subject 2's search process would have been improved if many sections of the script had not been omitted because of the disapproval she anticipated from the Faculty Member with whom she worked. The training should be revised to include discussion of the group dynamics of the ORSIDS process – and potentially difficult interactions with faculty members that may arise - including strategies to cope with resistant faculty members.
- ✓ The subjects did not spend the required time working on their own to familiarize themselves with the script. The training must incorporate a means of assessing the learners' grasp of its principles prior to delivery of the script. Additionally the revised training must be tested to gauge its effectiveness.

- The study found that the group dynamics between the Instructional Designer and the Faculty Member in the dyad can have a substantial impact on communication and the resulting efficacy of the process.

While the value of the ORSIDS process has been proven by the study, the Expert Panelists and the researcher agree that the ORSIDS script and related instructional design training should undergo further revision and usability testing. Further cycles of iterative development may be necessary for high-quality implementation of this innovative and complex information product. To create a high quality process script, iterative cycles of development and usability testing must be continued until no further flaws are revealed in the product.

Implications

The ORSIDS process has proven to be valid. Both field testing and summative evaluation have shown that ORSIDS is a useful process for both college employed faculty and instructional designers, that ORSIDS improves the instructional designer ability to assist the faculty member with integrating technology into the curriculum, and that the ORSIDS script itself, while in need of further testing and formatting revisions, is an effective tool.

The study has proven that a coaching interaction (specifically ORSIDS) in which the instructional designer communicates and dialogues about instructional design media selection theory in the context of the development of the faculty member's online class can result in technology-based curriculum ideas on the part of the faculty member. Some of the implications of the study are as follows:

- Instructional design theory can be taught quickly and effectively to faculty members in disciplines outside of instructional design.
- Instructional design theory can be transferred to the online setting

- The role of the instructional designer changes, or should change, in the context of the instructional designer/faculty member relationship developing higher education technology-based instruction.
- It may be fruitful to explore the college-based instructional design process from the social sciences perspective of small group work and group dynamics
- Finding an appropriate format for ORSIDS has been one of the major challenges of this developmental study.
- The training provided in the study was not sufficient to prepare the Instructional Designer Subjects with the content knowledge to flawlessly deliver the ORSIDS script. The method for transferring knowledge about ORSIDS to instructional designers needs some revision to be more effective.
- Once the ORSIDS script and training have been refined through further development and testing, they may have many other applications within the instructional deign domain.

Instructional Design Theory for Professional Development

This study clearly proved the effectiveness of teaching instructional design, and in particular media selection theory, to higher education faculty. This study showed that faculty members from disciplines outside of instructional design can quickly learn and can benefit from learning instructional design theory. In three out of the four tests, Faculty who were taught this theory responded by having original creative ideas connected to their curriculum and how it could be implemented through online resources.

In the fourth case, where the Faculty Member did not respond by having original creative ideas connected to the curriculum, the Instructional Designer did not clearly transmit the instructional design theory; many sections of the script had been omitted. The Instructional Designer may have been responding to signals from the Faculty Member indicating a lack of receptivity. In the summative evaluation, Expert Panel Member 2 provided feedback that concurred with the pilot study findings, stating that some faculty might resist portions of the ORSIDS script process. The study indicated that all faculty members may not necessarily be receptive to the ORSIDS process.

Instructional Design Theory Can Be Transferred To the Online Setting

This study demonstrated that instructional design media selection theory works when transferred to the online environment. With ORSIDS, the ASSURE method and elements of other media selection theories were modified for use in the online environment. The effectiveness of the consulting sessions supported with the ORSIDS script document the efficacy of instructional design theory when transferred to the online setting.

The Change in the Role of the Instructional Designer in Higher Education

There are many differences between the role of the instructional designer in the corporate and in the college-based setting. In the corporate setting the instructional designer works with someone with no particular attachment to the content who has been assigned as a subject matter expert; in the college based setting the instructional designers works with faculty on material considered his or her intellectual property.

The role of the instructional designer in the corporate setting is usually a directive one, leading the instructional design process and eliciting information from the subject matter expert who serves as a source of information but is not an equal participant in the instructional content development process. In some college-based settings, the respective roles of the instructional designer and faculty member are similar to the scenario that was just described; in such settings, the independent ability of the faculty member to integrate technology into his or her curriculum is not fostered.

The ORSIDS process endeavored to create a context in which the independent ability of the Faculty Member to integrate technology into the curriculum could be nurtured. In such a context, the Instructional Designer served as more of a coach leading the Faculty Member in decision making rather than making the decisions without him or her. The content development process was a collaborative one, with the Faculty Member being simultaneously supported and empowered to take the lead in decision making by the Instructional Designer. ORSIDS serves as a model demonstrating how providing the college-employed instructional designer with a consultative rather than a directive role can lead to the acquisition of greater technology-based skills on the part of the Faculty Members with whom he or she works.

The Potential of Exploring the Instructional Design Process from the Perspective of Human Factors and Sociology

Instructional design is a process that usually occurs between two individuals at a time, but in keeping with the finding that there has been scant attention paid to what instructional designers actually do (Schwier, Campbell & Kenney, 2004), little if any attention has been paid to the instructional design process from the social sciences perspective of small group work and group dynamics. It is clear that the dynamics of the interaction between the two people, the instructional designer and faculty member, have a great impact on its efficacy.

The potential fruitfulness of this approach was suggested by the study finding that the group dynamics between Instructional Designer Subject 2 and the Faculty Member with whom she worked prevented her from being as effective as she might have been otherwise. This Instructional Designer omitted several sections of the script because of the perception that they might displease or not be appropriate for the Faculty Member. In this test session, the Faculty Member did not generate any technology-based curriculum ideas. In the other tests, in which the power dynamics were more collaborative and collegial, the Faculty Members did generate technology-based curriculum ideas.

An explanation for the reason that three of the four Faculty Members improved their ability to generate technology-based ideas for curriculum when working with an Instructional Designer is borne out by research in social interaction and the sociology of small groups. Hill and Laughlin cited in Johnson (1992) found that individuals usually learn better and faster in the presence of others and that groups solve puzzles more quickly than individuals. As a process that relies heavily on small group interactions, the field of instructional design might benefit greatly from a perspective focusing on group dynamics.

Information usability

Finding an appropriate format to communicate the complex ORSIDS process both to Faculty Members and the Instructional Designers responsible for teaching it has been one of the major challenges of this developmental study. A complex and comprehensive task of this sort is hard to present simply without compromising the complexity of the information. Another major reason for the difficulty is that the instructional design process of online resource selection includes two types of information: (1) structured steps that benefit from clear direction and (2) more improvisatory activities that rely much more on variables within a given situation as well as individual judgment. Because the process embodied by ORSIDS has required a unique type of informational structure, it has provided a challenge for informational usability, development, and assessment.

Additionally instructional designers with different levels of expertise have different needs. Instructional designers with a good deal of ORSIDS-related content knowledge may do best with a job-aid-type format that cues them for decisions that need to be made and prompts them for content that they already know. Instructional Designer Subject 1 requested such a format. Instructional designers with less experience and content knowledge may benefit from a more directive and scripted approach.

Thus rather than incorporating both approaches into one script format as the current ORSIDS script currently does, ORSIDS might benefit from development of two distinct scripts – one that is more proscriptive and one that functions as more of as job aid – to meet the needs of instructional designers with different skill levels.

The format of ORSIDS has continually improved through the cycles of iterative testing and development. Further iterative cycles will probably result in a usable and high quality format. When this format is achieved, it may very possibly be applicable to a number of similar complex and comprehensive tasks within the college-based instructional design domain.

The Need for Improved ORSIDS-Related Training

The reasons for the errors in execution of ORSIDS appeared to be threefold: lack of needed content knowledge on the part of the Instructional Designers, lack of familiarity with the materials (insufficient time spent studying them), a need for a more usable script format, and alteration of the script based on group dynamics.

Lack of content knowledge might be compensated for with more thorough preliminary training and perhaps support by an expert during an instructional designer's first sessions. Neither Instructional Designer Subject spent the expected time with the ORSIDS materials prior to the testing sessions. That may have also caused some of the deficits in content knowledge.

This study was limited by the fact that full participation by the Instructional Designer Subjects involved an excess of 12 hours of time with no compensation of any type. While these subjects were generous, they did not spend sufficient time on self-study of the ORSIDS script, and this time was probably limited by the lack of compensation. Future testing of the script would be more effective if it were possible to compensate the Instructional Designer Subjects for at least 15 hours' worth of work.

Recommendations

As mentioned earlier, the feedback from the pilot testing and summative evaluation suggests a need for further testing and probable further development of the ORSIDS script and training process. As previously discussed, the need for development of two ORSIDS different script formats may be indicated - one that is more proscriptive and one that is more of a job aid – to meet the needs of instructional designers with different skill levels. The need for revised training is also needed, particularly to assess learner competency before progressing on to deliver the script.

Additionally, input from the Expert Panelists suggested that there are other best practices in the college-based instructional designer/faculty member course development process that while outside of the scope of this study should be documented. For example, one of the Expert Panelists suggested that college-employed instructional designers would benefit from the best practice of keeping a list of available high-quality online resources.

The ORSIDS process was demonstrated to assist Instructional Designers in effectively helping Faculty Members in integrating technology. Exploration is needed to find additional practical ways to support instructional designers in their mission of assisting faculty members and becoming more effective change agents. Ellis, Hafner and Mitropoulos (2004) suggest that faculty members are sometimes hesitant to relate to instructional designers because of the perception that doing so may erode their intellectual property rights and make them vulnerable to unwanted management intervention. In many cases this perception is not unwarranted. Integrating technology into the curriculum transforms what used to be a private space, the classroom, into a space that is public. With this transformation comes the potential for what is both positive and negative about being in the public realm. Instructional design support can and should embody what is potentially positive about a communal activity: providing genuinely helpful services that empower the individual faculty member to design effective online courses while simultaneously accomplishing the important task of diffusing technology into the curriculum.

Summary

The purpose in creating ORSIDS was to develop a process “script” to assist college-employed instructional designers in guiding faculty with selecting online media and multimedia resources for their online courses. The process script was developed to address three problems:

- The lack of online pedagogical skills possessed by online faculty
- The less than effective deployment of the college-employed instructional designers hired by colleges and universities to work with online faculty
- The lack of educator adoption of online resources, particularly learning objects and learning object repositories

ORSIDS was developed through a combination of research, internal and external expertise, and iterative cycles of formative evaluation and development. Usability and field testing took place which resulted in extensive changes to the format of the process script.

The ORSIDS process was ultimately validated. The respondents from the Expert Panel and testing subjects indicated that ORSIDS was of value in achieving the goals it was designed to address. The testing process also demonstrated that although all faculty may not be receptive to it, ORSIDS was an effective tool when properly delivered. To maximize the potential of ORSIDS, further testing and probable further format refinement will need to occur. The product will then need to be diffused to reach a larger audience. This is already starting to occur; the researcher has been invited to present a pre-conference workshop on the ORSIDS process at the 2005 Annual Conference on Distance Teaching and Learning in Madison, Wisconsin. If the format is perfected and diffusion is achieved, the ORSIDS script and process have the potential to be of great value in supporting college-employed instructional designers in their tasks of increasing faculty pedagogical design skills and assisting faculty members in integrating technology into the curriculum.

Appendix A

Criteria Candidates

Draft 1

Criteria Candidates for a Process Script for Online Resource Selection

A Process Script (Keppell, 2001) for Instructional Designers to help Online Faculty with Selection of Learning Objects for Their Online Classes Must Be One Which:

1) Assists the online instructor with identifying which part(s) of the curriculum needs amplification with learning objects ((Djikstra, 2001; Djikstra, Jonassen, & Sembill, 2001; Kemp, 2001; Steven Smith, personal communication, October 6, 2004)
2) Helps the online instructor to identify the conditions of learning required by the targeted curriculum area(s) that the online resource(s) must provide (Reiser & Gagne, 1983; Romiszowski, 1988)
3) Helps the instructional designer to determine the degree of assistance that the faculty member wants for the online resource selection process (Steven Smith, personal communication, October 6, 2004)
4) Is clear, simple and easily navigatable (Romiszowski, 1988) – in other words usable (Shneiderman, 1998)
5) Contains clear, simple, usable job aids that can be given to the online instructor to enable them to do some of the task on their own (Romiszowski, 1988)
6) Provides a search process and search resources for the instructional designer to use with the faculty member in addition to resources that can be given to the faculty member who wants to continue searching on his/her own (Steven Smith, personal communication, October 6, 2004; Wallace, 2004)
7) Provides a means to evaluate whether the resource is appropriate for the curriculum (Heinich, Molenda, Russell, & Smaldino, 2002) by asking the following questions:
    1) Does the resource meet the conditions of learning required by the curriculum area (Reiser & Gagne, 1983; Romiszowski, 1988)?
        a. Does the resource have the appropriate instructional attributes and physical attributes (Gagne, Briggs, & Wager, 1992) to implement the learning outcomes as determined by Reiser and Gagne (1983) and Romiszoswski (1988)?
            i. Does it provide the instructional message with the proper stimulus (Romiszowski, 1988)?
            ii. If applicable, does it accept student input in a manner that appropriately demonstrates their knowledge (Romiszowski, 1988)?
        b. Is the resource appropriate for the learner, considering factors such as age and ability to read (Gagne, Briggs, & Wager, 1992)?
    2) Is the resource credible, and will it have longevity as a link on the web (Steven Smith, personal communication, October 6, 2004)?
8) Provides a method for determining whether the resource places an acceptable amount of cognitive load on the learner (Clark & Mayer, 2003)
9) Provides a way to assess whether Mayer's multimedia principles for instructional message design have been incorporated (Mayer, 1999).
10) Provides a way to assess whether some of the more recent empirical findings regarding multimedia attributes have been incorporated (Reimann, 2003; Rouet, Levonen, & Biardeau, 2001)

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Criteria Candidate Validation Draft 2
Criteria Candidate Validation

Background on the Online Resource Selection Process Script

The purpose of this study will be to develop a process "script" to assist college-employed instructional designers in guiding faculty with selecting online media and multimedia resources for their online courses. The study will result in a script that will make it possible for instructional designers and online faculty members to work together effectively and to efficiently evaluate online resources for a given course. It will expand faculty member knowledge of course design as they become familiar with the prescribed multimedia selection techniques.

While scripts are rarely discussed in the instructional design literature, in practice most instructional designers rely upon them to do their jobs (Keppell, 2001). Scripts simplify communication between the instructional designer and subject matter expert. Such scripts provide a "shortcut" for the instructional designer in his or her work, making it possible to accomplish goals while using less of the subject matter expert's time. As the development process for higher education courses containing new media can be even more complex than traditional courses and the instructional designer workload in higher education has the potential to be more demanding, the need for such scripts becomes even greater.

The script developed in this study will aid the consulting and conceptualization/elicitation process between the instructional designer and online faculty member in the area of the selection of online resources. A script to guide faculty members with the media selection process required to select online resources will greatly aid the instructional designer in his or her role of change agent diffusing the innovation of learning objects and other online resources.

Introduction

This process script aligns with the ASSURE Model of Instructional Design (Smaldino, Russell, Heinich & Molenda, 2005): **A**nalyze learners; **S**tate objectives; **S**elect methods, media and materials; **U**tilize media and materials, **R**equire learner participation, **E**valuate and revise. This process script corresponds to the third phase of the model, Select methods, media and materials, and to Option 1 within that phase, Select available materials.

I am asking your assistance to validate the following criteria.

Inputs to the Process

Criteria #1 **Analysis of learners** based upon general characteristics such as age, reading ability, previous experience with subject, previous experience with online learning (Smaldino, Russell, Heinich & Molenda, 2005)

Criteria #2 A statement of each **learning outcome**, including the following: the audience for whom the objective is intended, the behavior or capability to be demonstrated, the conditions under which the behavior or capability will be observed, and the degree to which the new skill must be mastered (Smaldino, Russell, Heinich & Molenda, 2005).

Steps in the Process Script

Criteria #3 Decide which learning outcome(s) must be fulfilled with an online resource (Djikstra, 2001; Djikstra, Jonassen, & Sembill, 2001; Kemp, 2001; Steven Smith, personal communication, October 6, 2004))

Criteria #4 Determine the learning outcome category to which the specified learning outcome belongs (Reiser & Gagne, 1983).

Then for each selected learning outcome

Criteria #5 **Choose an instructional method** (Smaldino, Russell, Heinich & Molenda, 2005)

Criteria #6 **Choose a media format** based on the learning outcome and conditions of learning necessary to achieve the outcome (Smaldino, Russell, Heinich & Molenda, 2005)

Criteria #7 **Survey online learning resources/learning objects** (Smaldino, Russell, Heinich & Molenda, 2005)

Then select among available resources based upon the following:

Criteria #8 Does the resource meet the conditions of learning required by the curriculum area (Reiser & Gagne, 1983; Romiszowski, 1988)?

Criteria #9 Does the resource have the appropriate instructional attributes and physical attributes (Gagne, Briggs, & Wager, 1992) to implement the learning outcomes as determined by Reiser and Gagne (1983) and Romiszoswski (1988)?

Criteria #10 Does the resource provide the instructional message with the proper stimulus (Romiszowski, 1988)?

Criteria #11 If applicable, does the resource accept student input in a manner that appropriately demonstrates his or her knowledge (Romiszowski, 1988)?

Criteria #12 Is the resource appropriate for the learner, considering factors such as age and ability to read (Gagne, Briggs, & Wager, 1992)?

Criteria #13 Is the resource credible (Steven Smith, personal communication, October 6, 2004)?

Criteria 14# Will the resource have longevity as a link on the web or does a request need to be made to download it onto a server (Steven Smith, personal communication, October 6, 2004)?

Criteria #15 Does the resource place an acceptable amount of cognitive load on the learner (Clark & Mayer, 2003)?

Criteria #16 Is the resource compatible with Mayer's multimedia principles for instructional message design (Mayer, 1999)?

Criteria #17 Is the resource compatible with some of the more recent empirical findings regarding multimedia attributes (Reimann, 2003; Rouet, Levonen, & Biardeau, 2001)?

Outputs of the Process Script

Criteria #18 **One or more appropriate online resources** for each selected learning outcome (Smaldino, Russell, Heinich & Molenda, 2005)

Process Script Format

Criteria #19 The script will consist of text on paper

Criteria #20 It can be copied and used for each new instructional designer/online faculty member online resource selection interaction

Criteria #21 It will consist of directions in the second person for the instructional designer, an actual script to be delivered verbatim or improvised form by the instructional designer, worksheets to be filled in and some reference materials.

Criteria #22 The process script will be clear, simple, intuitive, easily navigatable, and usable (Romiszowski, 1988; Shneiderman, 1998).

Reference Materials Included with the Script

Criteria #23 Searching Tips (Steven Smith, personal communication, October 6, 2004; Wallace, 2004))

Criteria #24 A Cognitive Load and Instructional Message Design Job Aid (Clark & Mayer, 2003; Mayer, 1999)

Criteria #25 A Multimedia Attribute Heuristic Guide (Reimann, 2003; Reiser & Gagne, 1983; Romiszowski, 1988; Rouet, Levonen, & Biardeau, 2001)

Efficiency/Cost of Using the System

Criteria #26 Use of the system will be more efficient and cost effective than conducting the same task without it.

Criteria Candidate Validation Draft 3

Background on the Online Resource Selection Process Script

The purpose of this study will be to develop a process "script" to assist college-employed instructional designers in guiding faculty with selecting online media and multimedia resources for their online courses. The study will result in a script that will make it possible for instructional designers and online faculty members to work together effectively and to efficiently evaluate online resources for a given course. It will expand faculty member knowledge of course design as they become familiar with the prescribed multimedia selection techniques.

While scripts are rarely discussed in the instructional design literature, in practice most instructional designers rely upon them to do their jobs (Keppell, 2001). Scripts simplify communication between the instructional designer and subject matter expert. Such scripts provide a "shortcut" for the instructional designer in his or her work, making it possible to accomplish goals while using less of the subject matter expert's time. As the development process for higher education courses containing new media can be even more complex than traditional courses and the instructional designer workload in higher education has the potential to be more demanding, the need for such scripts becomes even greater.

The script developed in this study will aid the consulting and conceptualization/elicitation process between the instructional designer and online faculty member in the area of the selection of online resources. A script to guide faculty members with the media selection process required to select online resources will greatly aid the instructional designer in his or her role of change agent diffusing the innovation of learning objects and other online resources.

Introduction

This process script aligns with the ASSURE Model of Instructional Design (Smaldino, Russell, Heinich & Molenda, 2005): **A**nalyze learners; **S**tate objectives; **S**elect methods, media and materials; **U**tilize media and materials, **R**equire learner participation, **E**valuate and revise. This process script corresponds to the third phase of the model, Select methods, media and materials, and to Option 1 within that phase, Select available materials.

I am asking your assistance to validate the following criteria.

Inputs to the Process

Criterion #1 **Analysis of learners** based upon general characteristics such as age, reading ability, previous experience with subject, previous experience with online learning (Smaldino, Russell, Heinich & Molenda, 2005)

Criterion #2 A statement of each **learning outcome**, including the following: the audience for whom the objective is intended, the behavior or capability to be demonstrated, the conditions under which the behavior or capability will be observed, and the degree to which the new skill must be mastered (Smaldino, Russell, Heinich & Molenda, 2005).

Steps in the Process Script

Criterion #3 Decide which learning outcome(s) must be fulfilled with an online resource (Djikstra, 2001; Djikstra, Jonassen, & Sembill, 2001; Kemp, 2001; Steven Smith, personal communication, October 6, 2004))

Criterion #4 Determine the learning outcome category to which the specified learning outcome belongs (Reiser & Gagne, 1983).

Then for each selected learning outcome

Criterion #5 **Choose an instructional method** (Smaldino, Russell, Heinich & Molenda, 2005)

Criterion #6 **Choose a media format** based on the learning outcome and conditions of learning necessary to achieve the outcome (Smaldino, Russell, Heinich & Molenda, 2005).

Criterion #7 **Survey online learning resources/learning objects** (Smaldino, Russell, Heinich & Molenda, 2005)

Then select among available resources based upon the following:

Criterion #8 Whether the resource meets the conditions of learning required by the curriculum area (Reiser & Gagne, 1983; Romiszowski, 1988).

Criterion #9 Whether the resource has the appropriate instructional attributes and physical attributes (Gagne, Briggs, & Wager, 1992) to implement the learning outcomes as determined by Reiser and Gagne (1983) and Romiszoswski (1988).

Criterion #10 Whether the resource provides the instructional message with the proper stimulus (Romiszowski, 1988).

Criterion #11 Whether, if applicable, the resource accepts student input in a manner that appropriately demonstrates his or her knowledge (Romiszowski, 1988)

Criterion #12 Whether the resource is appropriate for the learner, considering factors such as age and ability to read (Gagne, Briggs, & Wager, 1992).

Criterion #13 Whether the resource is credible (Steven Smith, personal communication, October 6, 2004).

Criterion 14# Whether the resource will have longevity as a link on the web or a request needs to be made to download it onto a server (Steven Smith, personal communication, October 6, 2004).

Criterion #15 Whether the resource places an acceptable amount of cognitive load on the learner (Clark & Mayer, 2003).

Criterion #16 Whether the resource is compatible with Mayer's multimedia principles for instructional message design (Mayer, 1999).

Criterion #17 Whether the resource is compatible with some of the more recent empirical findings regarding multimedia attributes (Reimann, 2003; Rouet, Levonen, & Biardeau, 2001).

Outputs of the Process Script

Criterion #18 **One or more appropriate online resources** for each selected learning outcome (Smaldino, Russell, Heinich & Molenda, 2005) for utilization in the online course and ultimately evaluation and possible revision.

Process Script Format

Criterion #19 The script will consist of text on paper.

Criterion #20 It can be copied and used for each new instructional designer/online faculty member online resource selection interaction.

Criterion #21 It will consist of directions in the second person for the instructional designer, an actual script to be delivered verbatim or improvised form by the instructional designer, worksheets to be filled in and some reference materials.

Criterion #22 The process script will be clear, simple, intuitive, easily navigatable, and usable (Romiszowski, 1988; Shneiderman, 1998).

Reference Materials Included with the Script

Criterion #23 Searching Tips (Steven Smith, personal communication, October 6, 2004; Wallace, 2004))

Criterion #24 A Cognitive Load and Instructional Message Design Job Aid (Clark & Mayer, 2003; Mayer, 1999)

Criterion #25 A Multimedia Attribute Heuristic Guide (Reimann, 2003; Reiser & Gagne, 1983; Romiszowski, 1988; Rouet, Levonen, & Biardeau, 2001)

Efficiency/Cost of Using the System

Criterion #26 Use of the system will be more efficient and cost effective than conducting the same task without it.

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Appendix B

Content for ORSIDS

Media Attributes

The Review of Literature section titled the “Instructional Attributes of Selected Media Types” contains descriptions of the instructional attributes of the following media:

- Text
- Audio
- Moving image (video)
- Animation
- Flat, still pictures

Cognitively Based Findings Related to Instructional Message Design (Mayer, 1999)

Mayer (1999) discovered that the following multimedia features result in better learning:

- When learners receive words and corresponding pictures rather than words alone (multimedia principle)
- When words and corresponding pictures are presented near rather than far from each other on the page or screen (spatial contiguity principle)
- When words and corresponding pictures are presented at the same time rather than at different times (temporal contiguity principle)
- When words are presented as narration rather than as on-screen text (visual split-attention principle) (Note, however, that accompanying visuals with auditory information is not always most effective cognitively. At times, text

- words – such as mathematical formulas or directions – are needed by the learner for memory support.)
- When concurrent non-verbal auditory information is minimized rather than maximized (auditory split-attention principle)
- When alternating visual and verbal information is presented in short rather than long segments (chunking principle)
- When extraneous material is eliminated rather than included (coherence principle)
- When learners have low rather than high prior knowledge and high rather than low spatial ability (individual differences principle)

Appendix C

Validated Requirements

Inputs to Process

- Requirement #1 Analysis of learners
- Requirement #2 A statement of each learning outcome
- Requirement #3 Acknowledgement of Context including task responsibilities of instructional designer and faculty member, technological capabilities of the students' computer equipment, students' computer skills, and students' online learning and multimedia skills

Steps in the Process Script

Learning Outcome Analysis Steps

- Requirement #4 Decide which learning outcome(s) (or portions of a learning outcome) should be fulfilled with an online resource
- Requirement #5 Do a task analysis for the specified learning outcome.
- Requirement #6 Determine the learning outcome category to which the specified learning outcome belongs

Research and Gather Online Resources Steps

- Requirement #7 Choose an instructional method
- Requirement #8 Lecture/demonstration of multimedia formats and their uses.
- Requirement #9 Choose a media format (limited to those commonly found in online resources such as MERLOT.)
- Requirement #10 Survey online learning resources/learning objects.

Learning Resource Evaluation Steps

- Requirement #11 Whether the resource can fulfill the learning outcome task analysis requirements
- Requirement #12 Whether the resource has the appropriate instructional and physical attributes
- Requirement #13 Whether, if applicable, the resource accepts student input in a manner that appropriately demonstrates his or her knowledge
- Requirement #14 Whether the resource is appropriate for the learner
- Requirement #15 Whether the resource is credible.
- Requirement #16 Whether the resource will have longevity as a link on the web or a request needs to be made to download it onto a server.
- Requirement #17 Whether the resource places an acceptable amount of cognitive load on the learner.
- Requirement #18 Whether the resource is compatible with Mayer's as well as Fleming and Levie's principles for instructional message design.
- Requirement #19 Whether the resource is compatible with findings related to media attributes including some of the more recent empirical findings regarding multimedia attributes.
- Requirement #20 Is the online resource affordable?

- Requirement #21 If there is a choice among resources, has the need to accommodate various learning styles been acknowledged with selection of the resource that will add the most diversity to the instruction?

Outputs of the Process Script

- Requirement #22 One or more appropriate online resources for each selected learning outcome for utilization in the online course.

Process Script Format

- Requirement #23 The script will consist of text on paper and will include a decision tree. It will be supplemented by demonstrations on the computer for the faculty member by the instructional designer.
- Requirement #24 It can be copied and used for each new instructional designer/online faculty member online resource selection interaction.

- Requirement #25 It will consist of directions in the second person for the instructional designer, an actual script to be delivered verbatim or improvised form by the instructional designer, worksheets to be filled in and some reference materials.
- Requirement #26 The process script will be clear, simple, intuitive, easily navigatable, and usable

Reference Materials Included with the Script

- Requirement #27 Searching Tips
- Requirement #28 A Cognitive Load and Instructional Message Design Text Job Aid
- Requirement #29 A Multimedia Attribute Heuristic Guide
- Requirement #30: A Description of Learning Outcome Categories
- Requirement #31: Definition of Instructional Methods
- Requirement #32: Explanation of Task Analysis

Appendix D

ORSIDS System Requirements Document

Instructional Problem(s) the Product will Address

This product will address instructional problems for two different groups, college-based instructional designers and faculty members who are putting courses online:

For faculty members:

- It will teach instructional design methodology necessary for online resource selection (the ORSIDS process)
- It will teach the analysis phase of instructional design methodology as a prerequisite to the ORSIDS process
- It will teach the online searching process
- It will teach an evaluation process for online resources

For instructional designers:

- It will teach the ORSIDS process with emphasis placed on best teaching practices

Learner Characteristics

Faculty Members

Faculty members are college instructors. People in this position will have at minimum a college degree, and the great majority will have an advanced degree. Their knowledge of formal teaching and educational practices, and their interest in such topics, may vary widely. The same is true of their experience and knowledge of online resources and teaching techniques.

Instructional designers

Instructional designers are college-employed instructional designers. Most people in this position will have at minimum a college degree. While many will have an advanced degree in instructional technology or a related field, that will not always be the case. They will have a range of instructional design, online searching, media selection and media production skills. Most will have some knowledge of education and or curriculum design.

The Instructional Objectives for both faculty and instructional designers will be based on the Validated Requirements.

Teaching/Instructional Strategies

For Faculty

Use a combination of lecture/dialogue, computer demonstration, information elicitation and collaborative decision making to deliver the ORSIDS process.

For Instructional designers

Use a combination of demonstration, modeling, and text analysis to teach delivery of the ORSIDS script.

Appendix E

Basic ORSIDS Outline

I Prerequisites

A. Analysis of learners

B. Learning Outcome Statements

C. Context Analysis
   1. Task responsibilities of instructional designer and faculty member
   2. Technological capabilities of the students' computer equipment
   3. Students' computer skills
   4. Students' online learning and multimedia skills

II Steps in the Process Script

A. Learning Outcome Analysis Steps
   1. Decide which learning outcome(s) (or portions of a learning outcome) should be fulfilled with an online resource
   2. Do a task analysis for the specified learning outcome.
   3. Determine the learning outcome category to which the specified learning outcome belongs

B. Research and Gather Online Resources Steps
   1. Choose an instructional method
   2. Lecture/demonstration of multimedia formats and their uses.
   3. Choose a media format (limited to those commonly found in online resources such as MERLOT.)
   4. Survey online learning resources/learning objects.
   5. Find one or more appropriate online resources for each selected learning outcome

C. Learning Resource Evaluation Steps
   1. Fulfill the learning outcome task analysis requirements?
   2. Appropriate instructional and physical attributes?
   3. Appropriate acceptance of student input?
   4. Appropriate for the learner?
   5. Credible?
   6. Longevity?
   7. Acceptable amount of cognitive load?
   8. Compatible with Mayer's as well as Fleming and Levie's principles for instructional message design.
   9. Compatible with current findings related to media and multimedia attributes
   10. Affordable?
   11. Accommodation of various learning styles if possible?

Appendix F

Detailed ORSIDS Outline

I Prerequisites

D. Analysis of learners

E. Learning Outcome Statements

F. Context Analysis
  1. Task responsibilities of instructional designer and faculty member
  2. Technological capabilities of the students' computer equipment
  3. Students' computer skills
  4. Students' online learning and multimedia skills

II Steps in the Process Script

B. Learning Outcome Analysis Steps
  1. Decide which learning outcome(s) (or portions of a learning outcome) should be fulfilled with an online resource
     a. Specify questions to ask and things to consider
     b. Refer to resources specified in the Requirements
     c. Do a flow saying this or this?
  2. Do a task analysis for the specified learning outcome.
     a. Refer to Task Analysis sheet
     b. Can contents from there go here?
  3. Determine the learning outcome category to which the specified learning outcome belongs
     a. Refer to Learning Outcome Category sheet
     b. Can contents from there go here?

B. Research and Gather Online Resources Steps
  1. Choose an instructional method
     a. How do you get to instructional method from learning outcome category and task analysis?
     b. Check with references listed in requirement for this step, also Smith & Ragan?
  2. Lecture/demonstration of multimedia formats and their uses.
     a. Leave to ID to do based on media formats suitable for instructional methods chosen?
     b. Prepare something to demonstrate commonly utilized methods and media types?
  3. Choose a media format (limited to those commonly found in online resources such as MERLOT.)
     a. How do you get to instructional method from learning outcome category, task analysis and instructional method?
  4. Survey online learning resources/learning objects.

5. Find one or more appropriate online resources for each selected learning outcome

C. Learning Resource Evaluation Steps

1. Fulfill the learning outcome task analysis requirements?
    a. Do on case by case basis – ask what requirements were revealed and were they revealed?
2. Appropriate instructional and physical attributes?
    a. Do on case by case basis – ask what requirements were revealed and were they revealed?
3. Appropriate acceptance of student input?
    a. Same as above.
4. Appropriate for the learner?
    a. Ask from what you can anticipate about the learner, any reason it isn't appropriate?
5. Credible?
    a. What questions should be asked?
6. Longevity?
    a. Just a yes or no?
    b Talk about fact that student sites don't tend to have have longevity.
7. Acceptable amount of cognitive load?
    a. Explain issue
    b. Info related to cognitive load and games, animation, discovery research
8. Compatible with Mayer's as well as Fleming and Levie's principles for instructional message design.
    a. Develop list, then determine how to explore
9. Compatible with current findings related to media and multimedia attributes?
    a. Include learning type and attributes of media that fulfill
    b. The Heuristic Guide will be a biggie – this requirement should provide a path through the guide
10. Affordable?
11. Accommodation of various learning styles if possible?

D. Reference Materials Included with the Script

1. Searching Tips
2. A Cognitive Load and Instructional Message Design Text Job Aid
3. A Multimedia Attribute Heuristic Guide
4. A Description of Learning Outcome Categories
5. Definition of Instructional Methods
6. Explanation of Task Analysis

Appendix G

ORSIDS Observation Recording Form

Date____

Instructional Designer__________________________________

Faculty Member_______________________________________

Course____

****
1. Script Delivery
Did the instructional designer outline the structure and purpose of the session? Could the instructional designer be seen and heard? Were the key points explained clearly? Did the instructional designer summarize the conclusions?

2. Learner Response
Were explanations clear to the faculty member? From the observed response was the session stimulating for the faculty member? Did it relate to their apparent needs? Was the instructional designer successful in stimulating learner participation and interaction? Was the instructional designer successful in helping to find useful online resources?

Strengths	**Weaknesses**
Introduction	
Step 1: Which learning outcomes are good candidates	
Step 2: Guide the task analysis	
Step 3. Choose learning outcome category?	

Step 4. Choose instructional methods	
Step 5. Select potential media formats	
Step 6. Provide a lecture/demonstration	
Discuss cognitive load and message design issues	
Step 7:Search	
Intro to Evaluation	
Criteria 1. Does the resource fulfill learning needs from the task analysis?	
Criteria 2. Appropriate instructional and physical attributes?	
Criteria 3: Accept student input in an appropriate manner?	

Criteria 4: Appropriate for the learner?	
Criteria 5. Is the resource credible?	
Criteria 6. Longevity of resource?	
Criteria 7. Amount of cognitive load?	
Criteria 8. Compatible with *Multimedia Attribute Heuristic Guide?*	
Criteria 9. Instructional diversity of resource?	
Criteria 10. Affordability of resource?	

3. Accommodations and resources
Did the computer and software work effectively? Were there any technical problems?

Strengths	**Weaknesses**

4. OVERALL QUALITY OF SESSION INCLUDING SEARCH RESULTS

Strengths	**Weaknesses**

AREAS FOR FURTHER SCRIPT DEVELOPMENT

SPECIFIC SUGGESTIONS FOR SCRIPT REVISION

Appendix H

Cognitive Walkthrough Form

Date____

Instructional Designer____

Faculty Member____

Course____

****
Was each of the following sections easy to learn, efficient to use, easy to remember, pleasing, resulting in few errors? Did it offer too much guidance or too little guidance? Any other comments about the script section?

Strengths **Weaknesses**

Introduction	
Step 1: Which learning outcomes are good candidates	
Step 2: Guide the task analysis	
Step 3. Choose learning outcome category?	
Step 4. Choose instructional methods	

Step 5. Select potential media formats	
Step 6. Provide a lecture/demonstration	
Discuss cognitive load and message design issues	
Step 7:Search	
Intro to Evaluation	
Criteria 1. Does the resource fulfill learning needs from the task analysis?	
Criteria 2. Appropriate instructional and physical attributes?	
Criteria 3: Accept student input in an appropriate manner?	
Criteria 4: Appropriate for the learner?	
Criteria 5. Is the resource credible?	

Criteria 6. Longevity of resource?	
Criteria 7. Amount of cognitive load?	
Criteria 8. Compatible with *Multimedia Attribute Heuristic Guide?*	
Criteria 9. Instructional diversity of resource?	
Criteria 10. Affordability of resource?	

3. Accommodations and resources
Did the computer and software work effectively? Were there any technical problems?

Strengths	**Weaknesses**

4. OVERALL QUALITY OF SESSION INCLUDING SEARCH RESULTS

Strengths	Weaknesses

FEELINGS ABOUT FORMAT?

DID THE SCRIPT MAKE IT EASIER TO TEACH INSTRUCTIONAL DESIGN SKILLS AND ACCOMPLISH THE TASK OF FINDING ONLNE RESOURCES THAN IF YOU DIDN'T HAVE IT?

AREAS FOR FURTHER SCRIPT DEVELOPMENT

SPECIFIC SUGGESTIONS FOR SCRIPT REVISION

Appendix I

Observation Report

This report summarizes the results of the testing that led to the current version of the Online Resource Selection Instructional Design Script (ORSIDS). There were two types of testing:

- Preliminary field tests conducted by the investigator that resulted in the two alpha versions of the script and
- Pilot tests conducted by instructional designers trained on the script process and delivery resulting in the current version of ORSIDS.

Additional revisions resulted from feedback at the Instructional Designer training session.

This report deals primarily with the results of the pilot testing, but additionally includes minimal information on the field tests to provide an understanding of the evolution of the script development.

Purpose of the Study

The purpose of the study was to see whether the proposed solution, ORSIDS, could satisfactorily address three problems, one overarching problem and problems with two solutions put in place to mend the first.

- The overarching problem: a lack of online pedagogical skills possessed by online faculty.
- The two sub-problems:
    - The less than effective deployment of the college-employed instructional designers increasingly being hired by colleges and universities to work with online faculty.
    - The lack of educator adoption of online resources, particularly the learning objects and learning object repositories into which numerous organizations world wide have poured substantial financial resources.

General Results

Every testing session resulted in positive outcomes in relation to these three problems. Faculty increased their knowledge and confidence, and in some cases shifted lukewarm attitudes to much more positive, in relation to online pedagogy and their ability to adopt and evaluate online resources. Instructional designers were provided with a process to not only achieve some success in teaching instructional design methodology but also to assist educators in adopting online resources in a very short period of time. Every case of testing resulted in one or more online resources that were useful to the faculty member.

In the debriefings with the instructional designers that followed the testing sessions, they expressed positive attitudes towards the process. Both agreed that the script makes it far easier to teach instructional design skills and to accomplish the task of finding online resources than they could on their own. One test subject stated that the application is a great tool with many applications that is hugely practical, provides a straightforward process, and equalizes the playing field between instructional designers with a lot of knowledge and those without it. The subject reported that she walked away from the testing with new information that will contribute to her expertise and positively change her instructional design practice. The other test subject stated that the ORSIDS was very enlightening, comprehensive, and that it was good have a guide in order to be reminded of instructional design features.

However, both test subjects reported and displayed problems with the usability and format of the script, and in some cases minor elements of the content and the process itself. Research Question # 3 is “What will be the best format and composition to enable the script to meet the specified requirements?” This question has continually been explored through the process of refining and evaluating evolving iterations of the script.

Specific Changes Made to ORSIDS as a Result of the Field Testing

There were two field testing sessions conducted by the investigator. These resulted in the second alpha version and first beta script version. It should be mentioned that the investigator did not deliver the entire script verbatim, but at times used it as a guide. The faculty member subjects reported feeling very pleased both with the process and its outcomes. The primary finding from the first testing session was the necessity of having a very clear and distinct learning outcome to work with in the process. While the faculty subjects had been provided with training on learner analysis and developing learning outcomes, the first faculty member had changed topics between the training and the testing session and brought a syllabus with numerous wide ranging, nonspecific learning outcomes. In the interests of getting through the session in the time that had been allotted, the investigator did not take the time to refine the learning outcome at the outset. While the issue was worked around and the session had a positive outcome, the lack of specificity of the learning outcome proved problematic throughout the testing session. As a result, the investigator revised the testing process to require that the learning outcome be approved prior to future testing sessions.

The major issue from the second testing session resulted from the fact that the testing occurred at the faculty member's office rather than in the office of the investigator. Resources that were available on the investigator's computer including software plug-ins and URLS for the demo and search session were not available on that of the faculty member. The investigator anticipated the lack of availability of the URLs prior to the session and compensated for this through adding a process to the script. However, the lack of the plug-ins that impeded the demo was not anticipated, and a process was added to deal with times when the instructional designer would be visiting the faculty member in his or her office.

The investigator also made some additional changes to the script format on the basis of these two alpha testing sessions.

- In the alpha scripts, explanatory background material had been placed before the script itself in the interest of making the material to be read first available to the reader. However, this placement made it hard to access the script for use in the session with the faculty member. A decision was made to reverse the placement of these two sections but to indicate prominently on the Table of Contents that the Background Material should be read first.
- Additionally, the first two versions of the alpha script were color coded to indicate the difference between the literal script to be delivered, actions to be conducted, and questions to be asked of the faculty member. The investigator did not find the color coding to be a helpful affordance when actually delivering the script and decided instead to transform the script to a literal play script format with interactions on the left and words on the right, in an attempt to more successfully accomplish the desired functions.
- Also in the process of using the script to work with the faculty member, the investigator found that many decisions needed to be tracked. This led to the decision to develop a form on which the various decisions arrived at in the testing session could be recorded, the *ORSIDS Decision Tracking form*.

Specific Changes Made to ORSIDS as a Result of the Instructional Designer Training

The instructional designers were provided with training prior to participating in the testing sessions. It primarily consisted of modeling script use and associated discussion. The instructional designers were provided with the script to review prior to the training session. One of the designers made a suggestion to align the headings of two of the charts, the *Table of Learning Types and the Media Most Commonly Used for Them* and the *Multimedia Heuristic Guide*, for the sake of consistency leading to greater usability. This revision was made.

Specific Changes Made to ORSIDS as a Result of the Pilot Testing

As previously indicated, these sessions were successful both in teaching faculty instructional design skills and in finding online learning resources. However, usability and format problems were revealed through investigator observation and debriefing with the instructional designers at the end of the testing sessions. The investigator made changes to the script to increase usability and address the problems.

The problems included:

- Portions of the script being delivered out of order and/or context or being skipped
- Some difficulty in conveying the relationship between learning outcomes and the media to fulfill them
    - Understanding and using the demo to present the meaning of media instructional and physical attributes
    - Understanding that an online resource does not have to comprise the entire solution for fulfilling a learning outcome but can be combined with other instructional media
- Difficulty to varying degrees with the task analysis step
- Difficulty to varying degrees in use of the Multimedia Heuristic

It should be noted that both instructional designers are very experienced corporate instructional designers with over 15 years each of work in the field. Their inclination is not to work verbatim from a script but to engage as much as possible in the interaction with the faculty member. The need of these instructional designers is to be able to get information at a glance. Less experienced instructional designers might feel more comfortable in delivering a script verbatim. However, neither subject specializes in the use of media or online instruction. Additionally neither spent the recommended amount of self-study time with the script and its background information.

On the basis of the pilot testing, the following major changes were made to ORSIDS:

- The main change is that the ORSIDS format was modified to incorporate keywords on the left hand side of the script to supply more "at-a-glance" performance support. Detailed directions were removed and placed in the section on *Background Information and Supplementary Materials*.

- The performance of the instructional designers revealed that they didn't sufficiently understand the concepts of instructional and physical attributes of media and how online resources can be used to fulfill or partially fulfill learning outcomes. This was previously addressed in the Task Analysis section, but apparently not adequately. The Media section was revised to incorporate more information about media attributes. This added information should help with the administering of the Multimedia Heuristic which is also contained in this section. These concepts and their application should also be more fully addressed in the training.

- The Multimedia Heuristic Guide was revised to add information in the heading about what was contained on each page. One of the instructional designers was confused and asked for this change.

- The ORSIDS Decision Tracking Form was modified to include process keywords to transform it into a more supportive job aid.

Appendix J

Abbreviated Validated Requirements and Their Implementation in ORSIDS

Inputs to Process

Requirement #1 Analysis of learners

Requirement #2 A statement of each learning outcome

Requirement #3 Acknowledgement of Context

- Task responsibilities of instructional designer and faculty member
- Technological capabilities of the students' computer equipment
- Students' computer skills
- Students' online learning and multimedia skills

Steps in the Process Script

Learning Outcome Analysis Steps

Requirement #4 Decide which learning outcome(s) (or portions of a learning outcome) should be fulfilled with an online resource

Requirement #5 Do a task analysis for the specified learning outcome.

Requirement #6 Determine the learning outcome category to which the specified learning outcome belongs

Research and Gather Online Resources Steps

Requirement #7 Choose an instructional method

Requirement #8 Lecture/demonstration of multimedia formats and their uses.

Requirement #9 Choose a media format (limited to those commonly found in online resources such as MERLOT.)

Requirement #10 Survey online learning resources/learning objects.

Learning Resource Evaluation Steps

Requirement #11 Whether the resource can fulfill the learning outcome task analysis requirements

Requirement #12 Whether the resource has the appropriate instructional and physical attributes

Requirement #13 Whether, if applicable, the resource accepts student input in a manner that appropriately demonstrates his or her knowledge

Requirement #14 Whether the resource is appropriate for the learner

Requirement #15 Whether the resource is credible.

Requirement #16 Whether the resource will have longevity as a link on the web or a request needs to be made to download it onto a server.

Requirement #17 Whether the resource places an acceptable amount of cognitive load on the learner.

Requirement #18 Whether the resource is compatible with Mayer's as well as Fleming and Levie's principles for instructional message design.

Requirement #19 Whether the resource is compatible with findings related to media attributes including some of the more recent empirical findings regarding multimedia attributes.

Requirement #20 Is the online resource affordable?

Requirement #21 If there is a choice among resources, has the need to accommodate various learning styles been acknowledged with selection of the resource that will add the most diversity to the instruction?

Outputs of the Process Script

Requirement #22 One or more appropriate online resources for each selected learning outcome for utilization in the online course.

Process Script Format

Requirement #23 The script will consist of text on paper and will include a decision tree. It will be supplemented by demonstrations on the computer for the faculty member by the instructional designer.

Requirement #24 It can be copied and used for each new instructional designer/online faculty member online resource selection interaction.

Requirement #25 It will consist of directions in the second person for the instructional designer, an actual script to be delivered verbatim or improvised form by the instructional designer, worksheets to be filled in and some reference materials.

Requirement #26 The process script will be clear, simple, intuitive, easily navigatable, and usable

Reference Materials Included with the Script

Requirement #27 Searching Tips

Requirement #28 A Cognitive Load and Instructional Message Design Text Job Aid

Requirement #29 A Multimedia Attribute Heuristic Guide

Requirement #30: A Description of Learning Outcome Categories

Requirement #31: Definition of Instructional Methods

Requirement #32: Explanation of Task Analysis

	Where Addressed in ORSIDS	**Additional Notes**
Requirement		**.**
Inputs		
1	**Background Information, Page 33**	**The discussion of Learner Analysis in the training was quite useful to the faculty members.**
2	**Background Information,**	**The issue of the importance of properly formulated learning objectives for this process**

	Page 33	**became very clear in the pilot testing. See the Observation report for further discussion. It seems to be harder for Humanities faculty to articulate clearly defined learning objectives than those in more proscriptive disciplines.**
3	**Background Information, Page 33 - 34**	**This portion wasn't able to be thoroughly tested. It involves inputs to the study and occurs prior to the study's scope.**
Script Steps		
Learning Outcome Analysis		
4	**Step 1 in Script and in Background Information**	**This section underwent some revision as a result of the Instructional Designer Training.**
5	**Step 2 in Script and in Background Information**	**Task Analysis requires independent judgment and cannot really be "scripted". It proved somewhat challenging for the subjects.**
6	**Step 3 in Script and in Background Information**	**This section went well for the subjects.**

Research and Gather Online Resources		
7	**Step 4 in Script and in Background Information**	**This section basically went well for the subjects. One instructional designer made a decision to leave out parts of it that perhaps she shouldn't have because of assumptions about the faculty member's prior knowledge.**
8	**Step 6 in Script and in Background Information**	**This demo went very well for one subject; the other subject showed the applications but didn't discuss the attributes that they were intended to demonstrate and skipped some crucial ones because she thought the content might not appeal to the faculty member. One of the applications was very effective at demonstrating challenging cognitive load. In the field testing it became apparent that the protocol would have to be slightly different if one visited someone else's office. ORSIDS was modified to accommodate for that.**
9	**Step 5 in Script and in Background Information**	**This was a difficult step for the instructional designers to execute. It required a lot of improvisation and independent judgment to appropriately apply the Multimedia Heuristic Guide. One subject had a hard time with its headings. Also the subjects didn't have the necessary knowledge about the instructional and physical attributes of media. They also needed more information to understand that an online resource does not have to comprise the entire solution for fulfilling a learning outcome but can be combined with other instructional media. This section was revised to hopefully supply that.**
10	**Step 7 in Script and in Background Information.**	**Both subjects were ultimately successful in finding online resources but didn't follow all of the script directions in the correct order Searching requires a lot of independent judgment and is not really possible to "script". One subject suggested that it would be good to provide more suggested repositories and searching protocols for each, but I didn't make those**

		changes as I felt that was outside the scope of the script. One instructional designer forgot to provide a list of the resources to the faculty member at the end of the process. Forgetting steps of that sort will hopefully be remedied through including keywords on the left of the script. It should also be mentioned that while the script discusses the fact that searching can happen in different ways, the script only presents the option of instructional designer and faculty member searching together. The process as it is borders on being overlong, and having the instructional designer search for the faculty member doesn't address the problem that this study is meant to address which is faculty members acquiring course development skills through working with an instructional designer.
Evaluate Learning resources		
11-21	**Step 8 in Script and in Background Information.**	**The discussion of these evaluation criteria went pretty well. While the initial process specified that they be applied to all resource candidates, it wasn't practical in practice to apply them to more than one or two top candidates. The discussion of longevity didn't tend to include whether the resource should be downloaded onto a server because it didn't apply.** **At the initial expert panel meeting, the panel felt that Requirement 19 was not important and agreed to its addition because I championed it. I have come to agree that it is not appropriate to fully implement this requirement because users cannot absorb all of the information, and so I implemented it only quite generally in the Multimedia Heuristic Guide.**
Output		
22	**Step 7 in Script**	**It is really important that it is clear that the goal is to find and evaluate just one or two resources. One of the subjects' learning objectives specified seven, and the instructional designer working with her felt unsuccessful**

		that she wasn't able to find them all but found one and formulated a plan for finding the rest. She consequently didn't evaluate the resource that *was* found but the ideal results of the proposed plan. The script has been revised to clarify the number of expected resources..
Format		
23		**The script does consist of text on a paper and a computer demo, but there is no decision tree. As I developed the process, I discovered that there are actually fewer decisions resulting in just one choice than originally anticipated. Most involve a number of options and cannot be precisely delineated (or it was beyond the scope of this study to do so.). Tables were developed (the *Table of Learning Types and the Methods Most Commonly Used for Them*, the *Table of Learning Types and the Media Most Commonly Used for Them*, and the *Multimedia Heuristic Guide*) to present various options. These tables met with a lot of approval with subjects in the field testing.**
24	**The entire document**	
25	**Directions and reference materials are in the background materials, and the script itself consists of an actual script with keywords as well as some tables. The ORSIDS Decision Tracking Form is a worksheet to keep track of decisions.**	
26	**The entire document**	**This is the requirement that has proven to be the greatest challenge. ORSIDS has undergone many changes to achieve this requirement, and would probably benefit from further testing. The literature reveals that reducing massive amounts of complex material to a simple and usable format is often a challenge. Furthermore, the type of format that would work best for one type of user will not necessarily be best for everyone.**

Reference Materials		
27	**Step 7 in Script and in Background Information**	**This was popular.**
28	**Step 8, Criteria 7 in Script and in Background Information**	**I limited the guidelines to a small selection of Mayer's and Fleming and Levie's principles. Sitting through this explanation was sometimes hard for people after going through this extensive process, particularly when their chosen resource didn't have any complex instructional message design issues.**
29	**Step 5 in Script and in Background Information**	**There is also a summary table preceding it.**
30	**Step 3 in Background Information**	
31	**Step 4 in Background Information**	
32	**Step 2 in Background Information**	

Appendix K

Final Version of ORSIDS Script

Note to Readers:

Read Section II, Background Information and Supplementary Materials, first. The script is placed first for easy access at Online Resource Selection meetings.

****

Table of Contents

Forms and Tables

ORSIDS Decision Tracking Form

Validated Learning Outcome to be Fulfilled with Online Resources

____
____
____

Analyze Learning Outcome's Fulfillment Requirements
Tasks or subtasks that need fulfillment with online learning resources
____
____

Determine Learning Outcome Categories (Check all that Apply)
Motor skills___ Attitudes___ Cognitive Strategies___ Verbal __
Intellectual Skills___
Procedures___ Principles___ Concepts___ (Abstract or Concrete)___

Assign Instructional Methods (Check all that Apply)
Drill and Practice___ Educational game___ Simulation___
Problem Solving___ Discovery Learning_____
Presentation___ Demonstration___ Dialogic___

Analyze Possible Media
Text___ Audio___ Animation___ Video___ Photos___
Drawings___ Graphics___ Diagrams___ Audio with visuals___
Text with visuals___ Audio with visuals and text___

For each task or subtask, answer the following questions related to needed media attributes:

1. What instructional attributes are needed? 2. Physical attributes? 3. How must student input be accepted?
Task____
____

Task____
____

Task____
____

Search for Resource Candidates____________________________________
____
____
Resources that Passed Evaluation___________________________________
____

SCRIPT

Interaction keywords	*What is Said*
Introduce the Meeting Agenda	**Instructional Designer (ID):** Thank you for coming today. We have a lot of ground to cover in our meeting in order to find and make wise discriminations among online learning resources. We will do the following things.
Determine if learning outcome is a good candidate	First we'll determine which of your learning outcomes are good candidates for fulfillment with online learning resources. We'll choose only one or two to work with and focus on one at a time.
Do task analysis	Then we'll do a task analysis for the specified learning outcome(s).
Determine learning outcome categories	Then I'll teach you about learning outcome categories and we'll decide which category the learning outcome belongs to.
Assign instructional methods	Next I'll introduce you to instructional methods so we can determine which methods are appropriate for the learning outcome.
Analyze media attributes	Next we'll learn about media formats and the instructional and physical attributes that they provide. Then we'll think about the attributes needed to fulfill your learning outcome so that we can look for them in an online learning resource
Multimedia demo	Then I'll provide a small lecture/demonstration on the computer of various multimedia formats, methods and their uses.
	Then we will search together for online resources for one of your learning outcomes.
Search for resources	Finally we'll choose one or two resources to evaluate for use in your class.
Evaluate resources	

Interaction keywords	*What is Said*
Step 1: Determine which learning outcomes are good candidates for fulfillment with online learning resources. Goal: Determine is learning outcome a good candidate?	ID: Our first step is to determine whether one or more learning resources is needed, and if so what kind. Are there one or more of your learning outcomes that you would like to fulfill through use of an online learning resource because you believe it is needed to get your educational point across? 1A) Faculty member (FM): Yes (decisively).
Faculty member (FM) gives good pedagogical answer (IA). Go to Step 2.	ID: Which learning outcome(s) and why? The faculty member gives an answer that makes pedagogical sense. Go to Step 2. OR 1B) FM: Yes (indecisively). OR
Otherwise (IB, C, or D)	1C) FM: Maybe (indecisively). OR 1D) FM: No.
Ask questions to decide. Stop when you get an answer that makes sense, and go to Step 2.	Do you need to teach about a topic that is impossible to depict through mere text on a computer screen? ID: Is proficiency in a skill or recall of many facts needed? Does time need to be compressed in the content that you are presenting (for example, are you trying to teach about the growth and development of living things?)

Interaction keywords	*What is Said*
Write validated learning outcome on the tracking form.	Do you need to slow down a process to, for example, model a process normally invisible to the human eye because it happens so quickly? Is there a need to teach about dealing with a situation that is physically dangerous, such as driving a car or handling a dangerous substance? Do you want to provide a lab experience to your students? Do you want to provide your students with the opportunity to role play? Do you want to provide a light, fun activity? Do you want to replace drill and practice with an activity that is a bit more stimulating or entertaining?

Step 2. Guide the faculty member in doing a task analysis for each specified learning outcome Goal: To break the outcome down into all of its components and determine their order To begin thinking about useful learning resources Write ideas on the *Tracking Form*. Make sure you completely understand what the faculty member tells you.	**ID:** Now we will do what's called a task analysis for each learning outcome. A task analysis will make it possible to understand what the instruction that we are designing will require in order to be successful. First I will ask you to inventory any subtasks that the learner must accomplish to be successful in reaching your first learning outcome. (Give the faculty member some time to think and write down these subtasks.) Have you identified any subtasks? (Discuss each subtask with the FM to make sure that you understand it completely.)

Interaction keywords	*What is Said*
You can let the FM think it through with a pencil and paper.	**ID:** Do any of these subtasks consist of even smaller tasks? If so, is there special knowledge that is needed for them to be successfully accomplished? (If necessary, give the faculty member some time to think and write down these subtasks before discussing them to make sure that you understand them completely.)
Sequence the tasks.	**ID:** Next we will sequence these tasks and subtasks. To do so, it will be essential to identify whether knowledge from any of these tasks or subtasks is necessary to meet the requirements of other tasks or subtask.
Discuss the FM's ideas.	Are any of these tasks or subtasks prerequisites for others? **ID:** (asks only if the FM indicates that "yes", there is some prerequisite knowledge): Which? How is the knowledge prerequisite? **ID**: In what sequence do you think that the various subtasks and tasks should occur and be presented?
Then discuss which tasks and subtasks might be fulfilled with an online resource. Brainstorm.	**ID:** Are there any tasks or subtasks for which you would like some amplification with online resources, which you cannot fulfill adequately through other means? Which of these? (Limit the ones that you will actually work with to just one or two if there are several.) What features will the online resource have to have to adequately do the job? What features will the resource need, instructionally and physically to elicit the learning outcomes as needed? Will the resource need to accept input in a specific manner to appropriately demonstrate the student's knowledge?

Interaction keywords	*What is Said*
Step 3. Help the faculty member to determine the learning outcome category to which the specified learning outcome belongs. Goal: Determine learning outcome category Record one or more learning outcome categories on Tracking Form.	**ID**: In this activity I will be introducing you to the idea of learning outcome categories, and we will try to figure out together which category your outcome belongs to. By identifying the learning outcome category, we will actually be identifying what kind of learning is taking place. That will make it possible to more effectively determine the best way in which to teach the content.
Explain learning outcome categories. Motor skills	**ID:** Motor skills are skills that utilize motor capabilities such as printing letters, riding a bicycle, or opening a combination lock. Psychomotor skills must be physically practiced to be learned. Does this learning outcome represent a motor skill?
Attitudes	**ID:** Attitudes are learned affective states that affect a learner's choice of personal action. Does this learning outcome represent an attitude skill?
Cognitive strategies	**ID:** Cognitive strategies enable individuals to learn and solve instructional problems effectively. Does this learning outcome represent a cognitive strategy?
Verbal information	**ID:** Verbal information is also known as declarative knowledge. Such knowledge includes learning tasks requiring memorization and recall. It is the kind of knowledge that learners can state. Does this learning outcome represent verbal information?

Interaction keywords	***What is Said***
Intellectual skills	**ID:** Intellectual skills enable individuals to do something of an intellectual nature. They make it possible to understand symbols and conceptualizations, apply them across a broad variety of instances and circumstances and act upon them. In the early grades this relates to the mastery of basic skills; later it relates to demonstrating mastery of skills connected to more advanced topics. The intellectual skills category covers many tasks related to learning:
Procedures	• Procedures, the process in which steps should be taken to accomplish a desired outcome. Does this learning outcome represent learning about a procedure?
Principles	• Another category of intellectual skills is principles, relational rules that can be stated as “if-then” statements. Does this learning outcome represent learning about a principle?
Concepts	• Another category of intellectual skills is concepts, a set of specific things grouped together on the basis of common characteristics. There are two kinds of concepts, *concrete and abstract*.
Concrete concepts	Concepts grouped together on the basis of *physical characteristics* are called *concrete concepts*. Does this learning outcome represent a concrete concept?

Interaction keywords	***What is Said***
Abstract concepts Problem solving Summarize conclusions.	**ID:** Concepts grouped together on the basis of *the ideas that they represent* are called *abstract concepts.* Does this learning outcome represent an abstract concept? • Problem solving is another type of intellectual skill. It is defined as the ability to integrate previous knowledge of principles, procedures, declarative knowledge and cognitive strategies in such a way as to solve an unfamiliar problem. Do you need a reminder of what any of these terms mean? Does this learning outcome represent problem solving? (This step is concluded by summing up the conclusions that have been drawn about the learning outcome category or categories for the learning outcome.)

Interaction keywords	*What is Said*
Step 4. Help the faculty member to determine which instructional methods may be appropriate for the learning outcome. Goal: Determine instructional method(s). Record instructional method(s) on the Tracking Form.	**ID:** Now I'd like to introduce instructional methods so that we can think of one or more that might be suitable for your learning outcome. An instructional method identifies a type of instructional process. I'll be presenting instructional methods that are effective in a web-based environment and can be implemented through online resources. Some instructional methods are more appropriate for certain types of learning than others, and as I tell you about each, I'll explain these features to you.
Drill and Practice	The first is *drill and practice*. Drill and practice is suitable for any application that might otherwise utilize worksheets. This method is appropriate for tasks that require memorization and recall such as learning arithmetic tables and foreign language vocabulary and gaining keyboard proficiency. Drill and practice is particularly helpful for the learning outcome type of verbal information. **ID:** Was verbal information our learning outcome type? If so, might drill and practice be an appropriate method? If not, is there any other reason why drill and practice might be appropriate?
Educational games	Another method that is appropriate for verbal information and for intellectual skills is an *educational game*. A game can fulfill a number of purposes including letting the learner practice knowledge and skills; identifying skills that need to be learned; providing a review, a reward or change of pace; and providing the opportunity to practice familiar skills in an unfamiliar context to aid in transfer. Games may require learners to use problem solving skills or to supply content with a high degree of accuracy.

Interaction keywords	*What is Said*
	Might any of these game features be useful in presenting this learning outcome? Was the learning type verbal or intellectual skills? If intellectual skills, which ones, and how could a game be useful?
Simulations	A *simulation* is a case study of a specific social or physical reality with which the student takes on a specific role, interacts and learns as a result of that interaction. Well designed simulations can provide a learning experience unavailable through other means and can bridge the gap between the classroom and the real world. Simulations can be used to compress time, slow down processes, involve students, make it safe to experiment, control uncontrollable situations, make it possible to engage in activities that would not otherwise be possible, and repeat events limitlessly with variations. They can be used to replace or supplement lab experiments, role playing, and field trips. Simulations can be appropriate for many different learning outcome types depending upon their design. Some simulations can teach attitude learning, others cognitive skills, and some motor skills. Simulations can also be used to teach many different types of intellectual skills including processes, problem solving, principles and concepts. Additionally, in some cases, simulations can reveal student misconceptions about content and provide information about student problem solving strategies.

Interaction keywords	***What is Said***
	Would a simulation be an effective means to present the learning content?
Problem solving method	In the *problem solving method*, students are placed in an active role and need to solve a real-world problem. Such exercises are usually presented by dynamic visuals representative of an imagined or real world and other media-rich materials. While this method is similar to a simulation in that it places the learner in an active role with the need to solve a problem, it is different in that it involves one or more well-structured, discrete problems rather than interaction with a complex system in an open-ended exercise. Learning types addressed by this method most often include cognitive and intellectual skills. Does the learning outcome fall into the cognitive or intellectual skills type? If so, would problem solving be an effective means with which to present the learning content?
Discovery learning	*Discovery learning* presents problems to be solved utilizing an inductive approach. Discovery learning is primarily oriented toward the acquisition of intellectual skills. Through discovery learning, students discover rules, procedures, and other content-related knowledge. In discovery learning, students research questions using a variety of sources. A webquest is one example of discovery learning. In a webquest, the learner is guided in using the web to find information and then focuses upon analyzing, synthesizing, and evaluating the information that is discovered.

Interaction keywords	***What is Said***
Webquest	Are intellectual skills the learning type for this learning outcome? Would discovery learning be appropriate? How about a Webquest?
Presentation method	In the *Presentation* method, information is disseminated one-way to the learner. The presentation method can be used to present a broad spectrum of learning types, but by itself it does not provide the means to either reinforce the learning or assess how effective it has been for the learner. Would presentation be an appropriate method for all or part of this learning outcome? If so, which portion?
Demonstration method	The *demonstration* method depicts a skill or procedure to be learned. A demonstration can be a one-way communication like a presentation, or opportunities for questions, practice and/or feedback can be incorporated. The Demonstration method is most commonly used for attitude, motor and intellectual skills acquisition. Would a demonstration help to implement this learning outcome?
Dialogic learning method	A *dialogic learning method* assists learners in constructing new knowledge through social interaction using synchronous and asynchronous web-based technologies such as forums, e-mail, document sharing and virtual chat. Learning resources, either supplied by the instructor or found by the student, can be part of this environment. This method promotes learner articulation, reflection, and collaboration, activities that can be associated with the acquisition of intellectual, cognitive and attitude learning types.

Interaction keywords	*What is Said*
Show the *Table of Learning Types and Instructional Methods Most Commonly Used for Them*	Would a dialogic learning method help to implement this learning outcome? (At the end of this step, show the faculty member the following *Table of Learning Types and Instructional Methods Most Commonly Used for Them* to tie together the last two steps.)

Table of Learning Types and the Methods Most Commonly Used for Them

Psychomotor	**Attitudes**	**Cognitive**	**Verbal**	**Intellectual**	**Miscellaneous (aesthetic)**
simulation	simulation	simulation	drill-and-practice	simulation	presentation
presentation	presentation	presentation	presentation	presentation	demonstration
demonstration	demonstration	demonstration	games	demonstration	discovery
case study	case study	case study		case study	
role play	role play	role play		role play	
	dialogic	dialogic		dialogic	
		problem solving		problem solving	
				discovery	
				games	

Table of Learning Types and the Media Most Commonly Used for Them

	Text	Audio	Anima-tion	Video	Photos	Draw-ings	Graph-ics	Dia-grams	Audio & Visuals*	Text& Visuals	Audio & text	Audio & Visuals & Text*
Psychomotor		**X**		**X**					**X**			
Attitudes	**X**	**X**		**X**	**X**				**X**			**X**
Cognitive				**X**					**X**			**X**
Verbal	**X**		**X**	**X**	**X**		**X**	**X**		**X**	**X**	
Intellectual	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Miscellaneous (aesthetic)	**X**	**X**		**X**					**X**			**X**

*Visuals here generally consist of photos, simple animation or line drawings with arrows.

Multimedia Heuristic Guide Page 1

(For Psychomotor, Attitudes, and Verbal Learning Outcome Types with Selected Media Types)

	Text	Audio	Animation	Video	Photos	Drawings	Related Media Issues
Psychomotor Learning		*Can guide learning of motor skills* *Can teach verbal and musical components, allowing for practice*		*Can display physical skills and allow repeated viewing and practice*	*Can show position of people and things in motion*		
Attitudes Learning	*Compelling text can teach attitudes*	*Use of the voice of an admired, recognizable role model can be effective as can background music, sound effects & narration*		*Dramatic reenactments can change attitudes* *Can promote cultural understanding through showing other ways of life*	*Photos of people can change attitudes.*		
Verbal Learning	*Can be most efficient medium for good readers*				*Can illustrate concepts and aid retention* *Can identify people, places & things.*		*Provide opportunity for practice and feedback*
Related Learning Outcome Issues	*For memory support, leave information to be memorized on screen as text.*	*Make sure that audio segments can be replayed and replayed at reasonable intervals.* *Some students have a hard time learning from audio*	*Animations should be assessed carefully for potential cognitive load problems.*	*Video can be effectively replaced online with still photos, line drawings with arrows & simple animations supported by audio; assess video applications individually for problems*	*A multi-image presentation using 2 or more simultaneous photos to compare visual phenomena can be effective for different purposes*	*Can be better than photos because detail can be minimized or maximized through callouts.*	

Multimedia Heuristic Guide Page 2

(For Intellectual and Aesthetic Learning Outcome Types with Selected Media Types)

	Text	Audio	Animation	Video	Photos	Drawings
Intellectual Learning	*Can teach concepts and rules and fulfill other intellectual learning outcomes*	*Can guide learning of intellectual skills* *Dramatic audio segments can be used to introduce problems* *Can teach recognition and discrimination of audio stimuli*	*Can be used to simplify rapid and complex processes and to manipulate time & space*	*Can portray procedures and case studies* *Can show things too dangerous to see otherwise* *Teaches recognition & discrimination of relevant motion stimuli, teaches rules, principles, & models performance especially with human interaction*	*Can be used to teach processes.* *Can point out critical differences between objects & exaggerate differences* *Can identify people, places & things*	*Can display facts related to forms, equipment, computer screens & information invisible to the eye,* *Can show principles of operation of objects with working parts enclosed* *Can display critical differences among objects*
Aesthetic (miscellaneous) Learning		*Can be used for stories, poems, & oral histories*		*Can present artistic performances and storytelling and manipulate space & time*		
Related Learning Outcome Issues	*For memory support, leave information to be memorized on screen as text.*	*Make sure that audio segments can be replayed and replayed at reasonable intervals* *Some students have a hard time learning from audio*	*Animations should be assessed carefully for potential cognitive load problems.*	*Video can be replaced online with still photos, line drawings with arrows & simple animations supported by audio; assess online video applications individually for problems*	*A multi-image presentation using 2 or more simultaneous photos to compare visual phenomena can be effective*	*Can be better than photos because detail can be minimized or maximized through callouts.*

Multimedia Heuristic Guide Page 3

(For Psychomotor, Attitudes, Verbal and Intellectual Learning Outcome Types with Other Selected Media Types)

	Graphics	**Diagrams**	**Audio with Visuals**	**Text with Visuals**	**Audio with Visuals & Text**	**Related Media Issues**
Psychomotor Learning				*Drawings and photos can be sequenced to show steps in psychomotor skills.*		
Attitudes Learning			*Graphics could be effective*			
Verbal Learning	*Depicts concepts, phenomena, trends*	*Multi-Image diagram could show schematic next to actual components*		.	*Animation with audio can replace video.*	*Provide opportunity for practice and feedback*
Intellectual Learning	*Depicts processes, concepts, rules, phenomena, trends, interrelationships*	*Good for concepts, rules & can illustrate relationships.* *Multi-Image diagram could show schematic next to actual components*	*Diagrams good*	*Diagrams good/animated color diagrams with text can describe processes and tell how something works* *Drawings & photos can be sequenced to teach principles & show position of objects in motion or when being manipulated*	*Animation with audio can replace video*	*Animation with audio can replace video*
Related Learning Outcome Issues	*Graphics = graphs and charts. Graphs are a visual rep. of numerical data, charts a visual rep. of abstract concepts like org charts and time lines*	*Diagrams = visuals aiming at a clear depiction of an object or characteristics of an object, such as schematics, or flow diagrams*				

Interaction keywords	***What is Said***
Step 5. Select some potential media formats on the basis of the instructional and physical attributes needed to fulfill your learning outcome. Goal: Select possible media Note media decisions on Tracking Form. Consult the *Multimedia Heuristic Guide*. Look under the Learning Outcome Types. Discuss applicable media applications. Media physical attributes = the physical aspects of communication that the media are able to display Media instructional attributes can be determined by how the media supports the type of performance expected of learners as a result of the instruction. The *Table of Learning Types and the Media Most Commonly Used for Them is a* summary. Take a break.	**ID:** Now let's think about media and multimedia that could potentially work to fulfill your learning outcome. The media that we'll discuss fall into the categories of text, audio, animation, video, photos, drawings, graphics, diagrams, audio with visuals, text with visuals, audio with visuals and text. Graphics are defined as graphs and charts, diagrams are visuals aiming at a clear depiction of an object or characteristics of an object such as schematics or a flow diagram. Do you have any questions about these categories? (Engage in explanation and discussion as needed.) Let's look at two tables: the *Table of Learning Types and the Media Most Commonly Used for Them* and (2) the *Multimedia Heuristic Guide*. (The *Multimedia Heuristic Guide* presents some physical and instructional attributes of media that are linked to the ability to facilitate specific learning outcome types. The ID improvises from here in pointing out applicable information on the charts based on the learning types(s) that has been identified for the FM's learning outcome.) After looking at these tables, take a 15 – 20 minute break to let the faculty member clear his or her head from all the input.

Interaction keywords	*What is Said*
Step 6. Provide a small lecture/demonstration of various multimedia formats and their uses Goal: Demo media attributes and methods. Present each listed application discussing features and educational applications. **Bass Guitar Anatomy Game** http://mypage.iu.edu/~tomjanke/bassParts.html Drill and practice, interactive, drag and drop. Realistic drawing and sound effects. **Note Reading** http://www.emusictheory.com/drillNoteReading.html Drill and practice, provides feedback with animation and correct note or unpleasant sound effect.	**ID:** Here are some examples of educational methods and media on the web. I'll show them to you briefly and point out some of their features. This is the *Bass Guitar Anatomy Game*. It's a drill and practice and uses drag-and-drop. It is interactive, was done in Flash, and uses a realistic drawing and sound effects. It is found on Merlot, a higher education repository that contains many useful learning objects. We'll look at Merlot later when we look at several useful collections. This is *Note Reading*, another music application from Merlot. It is another drill-and-and practice that requires the learner to identify what they know and provides feedback. The features that it uses are a visual, auditory feedback consisting of a correct note or unpleasant sound effect, and animation.

Interaction keywords	*What is Said*
Explore Leonardo's Studio http://www.bbc.co.uk/science/leonardo/studio/ Discovery learning using text and quality visuals.	*Explore Leonardo's Studio* is an example of discovery learning. It has very high production value and is from the BBC. It uses text, and the visuals it uses are very high quality
Curriculum Bites: World War One http://www.bbc.co.uk/schools/worldwarone/soldier/ Discovery learning using visuals and text to stir emotions.	*World War One* is also discovery learning from the BBC. Using visuals and text, it is a good example of how text can be used to teach and stir the emotions.
Sea Monsters in Dino World http://www.bbc.co.uk/dinosaurs/chronology/seamonsters/index_all.shtml Discovery learning using animation, video, 3D visuals, zoom capabilities (Show the 3 D views and zoom capabilities, and click on *Basilosaurus* for the video option.)	*Sea Monsters in Dino World* is another example of discovery learning with animated maps and visuals of dinosaurs. 3D views and zoom capabilities are available. A video is available when you click on the *Basilosaurus*. Here you can see how video is used for discovery learning.
PBS jazz site/View video trailer http://www.pbs.org/jazz (Look under *A History of America's Music* link)	Here is a video asset that can either be used in the presentation or discovery mode.
PBS jazz site/Biographies **Same web site:** http://www.pbs.org/jazz (Left-hand links– choose an artist for an example.) Example of audio with visuals and text.	These jazz biographies are a good example of the use of audio with visuals and text.
Virtual Piano http://www.pbs.org/jazz/lounge/ (On the Jazz Lounge site, choose "Virtual Piano") Uses audio and two kinds of visuals. Potential cognitive load problem**.**	This simulation uses audio and two kinds of visuals. Can you see how learners unfamiliar with this topic could find themselves overwhelmed by all of the incoming information? That's what we call a cognitive load problem, and we want to try to avoid it in the resources that we choose. (See if the FM is familiar with the idea of cognitive load and if they need more of an explanation or want to talk about examples that they've seen.)

Interaction keywords	*What is Said*
Step 7. Search together for online resources. Goal: To find one or two appropriate online resources to partially or completely fulfill a learning outcome. Define search questions and search terms. Repository URLs are: • http://www.merlot.org/Home.po • http://www.academicinfo.net/digital.html • http://www.learner.org/amerpass/slideshow/archive_search.php • http://www.loc.gov/ • http://www.google.com/ (select Images option)	ID: Now we'll search with the goal of finding one or two resources that will partially or completely fulfill one of your learning outcomes (suggests some search terms and asks if the FM agrees.) (You may want to think further about synonyms for the concepts that you have identified and how you might narrow or broaden the topic. Use Roget's Thesaurus http://humanities.uchicago.edu/orgs/ARTFL/forms_unrest/ROGET.html if needed.) ID: Here are some examples of some repositories that are useful for finding academic online resources. They include Merlot, Academic Info, American Passages, Library of Congress, and Google Images.

Interaction keywords	*What is Said*
Spend around an hour. Keep track of the resources with bookmarks or by pasting them into an email. Also record the URLs on the *Tracking Form*.	**ID:** (figures out with FM which URLs or search engines to use to try and find learning objects and online resources. Then search until you find one or more promising resources in one of the following repositories.) • the previously discussed Merlot http://www.merlot.org/Home.po that contains many peer-reviewed learning resources that have been developed and contributed by other instructors. • the digital library collection at Academic Info http://www.academicinfo.net/digital.html • *American Passages: A Literary Survey (Annenberg/CPB)* http://www.learner.org/amerpass/slideshow/archive_search.php for various images, sound clips, text, and primary sources related to history and American literature or • Library of Congress http://www.loc.gov/ for visual, audio and textual artifacts from the Library of Congress Collection and links to digital collections around the world. • GOOGLE.COM and specifically the image search (advanced option) in GOOGLE images (http://www.google.com/) (If absolutely no useful resources can be found, a good case can be made for requesting limited development dollars if they are available.)

Below is a chart that contains some terms that you may want to use as you search for multimedia. For example, if you used GOOGLE Images Advanced Search, you could put your content term into "related to all of the words" or "related to the exact phrase" and then a number of the following terms (all of those that you might find useful) into the "related to any of the words" section". (This table was developed by Steven Smith, Manager of Instructional Media Services at Portland Community College. This searching step is also based largely on Smith's unpublished work).

Multimedia Searching Terms

Audio Terms	Image Terms	Simulation	Video Terms
au	art	Flash	avi
.au	bitmap	.swf	.avi
audio	bmp	animation	.mov
av	.bmp	java	.mpeg
.av	camera	javascript	.mpg
band	cartoon	"gif animation"	Realmedia
cd	gallery	media	clip
concerts	gif		clips
lyrics	.gif		drivers
multimedia	image		mjpeg
music	images		mov
noise	jpeg		movie
song	.jpeg		movies
sound	photo		mpeg
sound card	photos		mpg
sound cards	photographs		plugins
soundblaster	photograph		quicktime
sounds	pic		video
soundwave	pics		viewers
speakers	pcx		media
track	.pcx		
vocals	.pic		
wav	.pics		
.wav	picture		
	pictures		
	png		
	.png		
	tif		
	tiff		
	.tif		
	.tiff		
	Digital		

You may also want to use "higher education" and names of methods that you have identified as potentially useful as search terms. Use links from any good resources that you do find. If you are still coming up short, ask the faculty member to ask colleagues in their discipline if they are aware of any good online resources. A LISTSERVE can be especially helpful for this purpose.

Interaction keywords	*What is Said*
Step 8. Evaluate. Goal: Introduce evaluation criteria.	**ID:** Next we'll evaluate the online resource that we have found. (If there are more than one or two candidate resources, decide with the FM which seems to be most promising and evaluate them one by one.) We'll be determining its overall quality and suitability for your class. To do so, we'll judge the online resource against the following criteria: • Fulfillment of learning needs • Appropriate instructional and physical attributes • Appropriate acceptance of student input • Appropriateness for learners • Credibility • Potential longevity • Cognitive load and instructional message design • Compatibility with *Multimedia Attribute Heuristic Guide* • Diversity of instruction offered • Affordability

Revisit the Tracking Form for your answers to criteria 1 – 3. Fulfill task analysis?	**Criteria 1:** Does the resource fulfill the learning outcome task analysis partially or completely?
Appropriate instructional and physical media attributes?	**Criteria 2:** Does the resource have the appropriate instructional attributes and physical attributes to elicit the learning outcomes as needed?
Appropriate acceptance of student input?	**Criteria 3:** If applicable, does the resource accept student input in a manner that appropriately demonstrates his or her knowledge?
	ID: Does the resource adequately meet the needs from these three criteria that we previously specified? If not, do you still want to use the resource? Have you changed your mind about the needs or can they be met in another way?
Appropriate for learner?	**Criteria 4:** Is the resource appropriate for the learner as specified in the learner analysis?
Credible?	**Criteria 5:** Is the resource credible? Credibility can be an issue online even more than with print publications. Commercial sites tend not to be as credible as educational. The author and school affiliation are two elements to take into account.

	ID: Does this resource meet your standards for credibility, and why?
Longevity?	**Criteria 6:** Will the resource have longevity as a link on the web or will a request need to be made to download it onto a server? (Explain to the faculty member that if the site belongs to a grad student, there is a good chance that it may not have longevity. Discuss whether that seems to be true.)
Acceptable cognitive load and instructional message design? Read the following guidelines.	**Criteria 7:** Will the resource place an acceptable amount of cognitive load on the learner? Is the resource compatible with the following findings by Fleming and Levie and Mayer's multimedia principles for instructional message design?

Fleming and Levie's Instructional Message Design Principles and Mayer's Principles of Multimedia and Cognitive Load

Consider whether the resource is presented in such a way that it is easy to process. When too many different kinds of information are presented either visually or aurally, it can result in so much cognitive load that it is hard for the learner to understand. Fleming and Levie (1993) and Mayer (1999)* have published findings related to cognitive load. Does the online resource conform to the following principles?

Selected Findings of Fleming and Levie Related to Instructional Message Design

1. About seven items can be perceived at a glance in a familiar object, and about seven familiar items can be stored in memory. Does the resource tax these limits?
2. Attention can be elicited through the use of directions such as "look", "listen", "notice", and by asking questions and posing problems. Does the resource contain such scaffolding, or can you easily supply it?
3. By grouping message elements in chunks, comprehension can be facilitated. For example, three strings of three digits each is much easier to perceive than a string of nine digits.

   If there are numerous elements, have they been arranged appropriately spatially or ordered temporally?
4. Does the resource contain difficult concepts? If so, they should be broken into small, relatively easy steps.
5. Are there many elements to attend to? Presented elements should be limited to those necessary to fulfill learning outcomes.
6. Does the resource present objects? If so, the size of any unknown objects should be compared to the size of a known one.

*Fleming, M. & Levie, W. H. (1993). *Instructional Message Design: Principles from the Behavioral and Cognitive Sciences*. Englewod Cliffs: Educational Technology Publications.
Mayer, R. E. (1999). Multimedia aids to problem-solving. *International Journal of Educational Research*, 31(7), 611-623.

7. Consider that attention is elicited by changes in the features (such as color, movement, and shape) of materials being presented. Does the resource contain such
8. changes within itself or in relation to the instructional context in which it will be presented? Do these changes direct attention to the most relevant ideas in the message?

Mayer's Principles of Multimedia and Cognitive Load

Mayer (1999) discovered that the following multimedia features result in better learning. Consider whether they are true of the learning resource being considered.

- When learners receive words and corresponding pictures rather than words alone (multimedia principle)
- When words and corresponding pictures are presented near rather than far from each other on the page or screen (spatial contiguity principle)
- When words and corresponding pictures are presented at the same time rather than at different times (temporal contiguity principle)
- When words are presented as narration rather than as on-screen text (visual split-attention principle) (Note, however, that accompanying visuals with auditory information is not always most effective cognitively. At times, text words – such as mathematical formulas or directions – are needed by the learner for memory support.)
- When concurrent non-verbal auditory information is minimized rather than maximized (auditory split-attention principle)
- When alternating visual and verbal information is presented in short rather than long segments (chunking principle)
- When extraneous material is eliminated rather than included (coherence principle)

Compatible with *Multimedia Attribute Heuristic*? Refer to *Heuristic*, p. 18 - 20.	**Criteria 8:** Is the resource compatible with findings related to media attributes contained in The Multimedia Attribute Heuristic Guide?
Complements other instruction?	**Criteria 9:** If there is a choice among resources, have you acknowledged the need to accommodate various learning styles by choosing the resource that will add the most diversity to your instruction?
Affordable?	**Criteria 10:** Is the online resource affordable?
Conclusion • Summarize accomplishments • Make sure FM has record of found resources. • Clarify action plan.	**ID ends the meeting by summarizing what was accomplished and making sure that the FM has what he or she needs to continue with the search if applicable. It should also be stated that if a potentially useful learning object was identified but not discovered in the search, options can be explored for funding to develop such a resource if the environment makes that possible.**

BACKGROUND INFORMATION AND SUPPLEMENTARY MATERIALS

Greetings, Instructional Designer

This is a script to assist you in helping faculty members to select online resources for their classes. You may follow the script word for word, or you may adapt it with language with which you feel more comfortable. In particular, feel free to offer opinions and participate in discussion and brainstorming rather than just asking the faculty member for answers even when that is what is specified in the script. The process in which you will be engaged is meant to be a collaborative one which you are guiding.

It is also a process which should prove very helpful to the faculty member that you are assisting. Initially the faculty member will be unfamiliar with the process of selecting online resources. At the conclusion, the faculty member will leave you with one or more resources that will add value to the class that he or she is teaching! And hopefully the faculty member will have learned skills for independent searching in the future.

Prior to Your First Meeting

Inform the faculty member that certain information will have to be provided including (1) a learner analysis and (2) a statement for each learning outcome. **It is critical for the success of the process that learning outcomes be stated specifically and with precision. The format for each learning outcome should include the following components:**

- **The behavior that the learners will display as a result of what they have learned**
- **The degree to which they will display the behavior**
- **The conditions under which they will display the behavior**

<u>If there is any doubt as to the specificity or generality of the learning outcome, it is better to err on the side of specificity rather than generality.</u>

Go over the learning outcomes and audience analysis for the class before your meeting to familiarize yourself with the topic and to make sure that this assignment has been done correctly. If the faculty member is unable to correctly specify learning outcomes, you will have to make sure that they receive sufficient training to do so.

The following issues will also need to be clarified with the faculty member prior to introducing the use of online resources into the class. You may already know the answers to these questions and simply need to share the information. Or you may need to consult with the faculty member for the answers. These ideas may be unfamiliar, so you may want to initially introduce and explain the concepts and then have a follow-up conversation to actually make decisions about the following issues.

- Task responsibilities – will it be the instructional designer or the faculty member who will ask for copyright permissions and do long term maintenance of the course and related online resources?
- What technological capabilities can be assumed on the part of the students' computer equipment?
- What computer skills can be assumed on the part of the students?
- What skills in online learning and specifically those related to multimedia can be assumed on the part of the students?

After your discussion(s), document your decisions in a memo that you send to the faculty member, and keep a copy of it in the project file.

At Your Meeting

You will have a lot of ground to cover. At this meeting, you will:

1. Help the faculty member to determine which learning outcomes are good candidates for fulfillment with online learning resources
2. Guide the faculty member in doing a task analysis for the specified learning outcome.
3. Help the faculty member to determine the learning outcome category to which the specified learning outcome belongs.
4. Help the faculty member to determine which instructional methods may be appropriate for the learning outcome.
5. Help the faculty member to focus on the instructional and physical media attributes needed by the online learning resource to choose some potential media formats.
6. Provide a small lecture/demonstration of various multimedia formats and methods and their uses.
7. Search together for online resources and provide search tips to the faculty member enabling him or her to continue to search independently.
8. Evaluate one or possibly two resources for possible use.

The purpose of these steps is to collect online resource candidates and make wise discriminations during their evaluation. Note that if appropriate, steps 4 – 6 may be done in a different order.

Also note that while this process enables the instructional designer and faculty member to search together, it is not the only option. In some circumstances, if desired by the faculty member, the faculty member could search independently for all or additional online resources after being introduced to the searching process. A search and follow-up report by the instructional designer is also an option if compatible with the instructional designer's schedule.

Introduce the meeting by informing the faculty member of the meeting agenda. Use the following form to record the decisions that result from your discussions with the faculty member.

ORSIDS Decision Tracking Form

Validated Learning Outcome to be Fulfilled with Online Resources

____
____
____

Analyze Learning Outcome's Fulfillment Requirements
Tasks or subtasks that need fulfillment with online learning resources
____
____

Determine Learning Outcome Categories (Check all that Apply)
Motor skills___ Attitudes___ Cognitive Strategies___ Verbal __
Intellectual Skills___
Procedures___ Principles___ Concepts___ (Abstract or Concrete)___

Assign Instructional Methods (Check all that Apply)
Drill and Practice___ Educational game___ Simulation___
Problem Solving___ Discovery Learning_____
Presentation___ Demonstration___ Dialogic___

Analyze Possible Media
Text___ Audio___ Animation___ Video___ Photos___
Drawings___ Graphics___ Diagrams___ Audio with visuals___
Text with visuals___ Audio with visuals and text___

For each task or subtask, answer the following questions related to needed media attributes:

1. What instructional attributes are needed? 2. Physical attributes? 3. How must student input be accepted?
Task____
____

Task____
____

Task____
____

Search for Resource Candidates_____________________________________
____
____
Resources that Passed Evaluation___________________________________
____

STEP 1 *Help the faculty member to determine which learning outcomes are good candidates for fulfillment with online learning resources*

In this step you lead the faculty member through a series of questions to help to identify the purpose that a learning object or online learning resource can serve in fulfilling the learning outcome. The faculty member can respond in one of four ways:

- "yes" with a solid reason why. If the reason makes sense, pedagogically, you can move to the next step.
- "yes" with some uncertainty. This is an indicator that the faculty member needs some pedagogical support .
- "maybe" with some uncertainty. This is an indicator that the faculty member needs some pedagogical support .
- If the faculty member's answer is "no" it is unlikely that they have come to see you unless they have been sent by someone else. The other person may be right that an online learning resource might be helpful and the faculty member may need some pedagogical support. Or not.

Note that the faculty member may already know which learning outcomes are good candidates for enhancement with online learning resources and can tell you why in a way that makes pedagogical sense. If so, you can stop there and continue with step 2. Otherwise prompt the faculty member with the questions until you arrive at an answer that is pedagogically sound. If a valid reason for an online resource is identified through this process, move on to step 2. If no valid reason is identified, you may want to reconsider whether it makes sense to undergo this process.

Step 2 *Guide the faculty member in doing a task analysis for the specified learning outcome.*

Refer to the following Supplementary material: *Explanation of Task Analysis*, for background information on the Task analysis process. Note that a task analysis does not always need to be performed. If the learning outcome is precise and specific, there may not be any prerequisite knowledge or tasks that are components.

Supplementary Material - Explanation of Task Analysis*

Why Do a Task Analysis?
A task analysis is required for a solid understanding of the learning that is being designed. A task analysis is performed for each learning outcome to:

1. Define in detail the tasks and sub-tasks that the learning consists of
2. Understand which tasks and subtasks rely on others as prerequisite knowledge
3. Prioritize and sequence these tasks and subtasks for the sake of designing the learning
4. Refine the learning outcomes.

This makes it possible to more effectively engage in the actions that occur later in the script:

1. Specifying the knowledge type that characterize the learning outcome
2. Choosing instructional methods that result in learning
3. Selecting appropriate media and online learning resources
4. Developing performance assessments and evaluation

How to Do a Task Analysis

<u>For Each Learning Outcome:</u>

Inventory the Tasks	List all of the tasks that must be done for **s**uccessful execution
Decompose each Task into Components	Think about each task and determine whether it consists of smaller tasks. Identify these subtasks and any knowledge that is required.
Sequence Tasks and Subtasks	Determine whether any of the tasks or subtasks rely on prerequisite knowledge from the other tasks or subtasks. Then define the sequence in which instruction should occur to best facilitate learning.

* This explanation has been simplified and modified from information found in the following two sources. Refer to these sources for more information.

Jonassen, D. H., Tessmer, M. & Hannum, W. H. (1999). *Task Analysis Methods for Instructional Design.* Mahwah, NJ: Lawrence Erlbaum Associates.

Perform a Task Analysis located at
http://classweb.gmu.edu/ndabbagh/Resources/Resources2/taskanalysis2.htm
Accessed on 12/23/2004.

Step 3. Help the faculty member to determine the learning outcome category to which the specified learning outcome belongs. The script provides an explanation of each of the categories. Each explanation is followed by a question for the FM as to whether the category is applicable. Instead of asking the faculty member each of the questions, you can propose your own ideas and ask if they concur and/or brainstorm if appropriate. On the Tracking Form, make note of the answers that you come up with for use in the next step. Hopefully this process will make it possible to determine the learning outcome category to which the specified learning outcome belongs. But be aware that it is not always possible to get one conclusive answer. Some learning outcomes contain elements of several categories and may not fall neatly into one. When that is true, make note of all of the applicable categories on the Tracking Form for use in the next step.

Supplementary Material - Learning Outcome Categories*

Gagne and Briggs as cited in Reiser and Gagne (1983) identified the following learning outcome categories:

- *Motor* skills are skills that utilize motor capabilities such as printing letters, riding a bicycle, or opening a combination lock. Psychomotor skills must be physically practiced to be learned.
- *Attitudes* are learned affective states that affect a learner's choice of personal action.
- *Cognitive* strategies are capabilities that enable the individuals to learn and solve instructional problems effectively.
- *Verbal* information or declarative knowledge is the kind of knowledge that learners can state. Such knowledge includes learning tasks requiring memorization and recall.
- *Intellectual* skills enable individuals to understand symbols and conceptualizations, apply them across a broad variety of instances and circumstances and act upon them. Such skills enable someone *to do something* of an intellectual nature. In the early grades this relates to the mastery of basic skills; later it relates to demonstrating mastery of skills connected to more advanced topics. The intellectual skills category covers many tasks related to learning:
    - Procedures, the process in which steps should be taken to accomplish a desired outcome
    - Principles, relational rules that can be stated as "if-then" statements.
    - Concepts, a set of specific things grouped together on the basis of common characteristics that can be identified by a given name or symbol. Concepts can be *concrete* and identified by their physical characteristics or *abstract* and identified by the ideas that they represent.
    - Problem solving, the ability to integrate previous knowledge of principles, procedures, declarative knowledge and cognitive strategies in such a way as to solve an unfamiliar problem.

This information is adapted from Instructional Design by Smith and Ragan (1999). It can be found in chapters 5 and in 8 through 15. You may find that you would like to read further about these learning outcome categories and possibly keep a copy of the book to reference during your consultations until you become very familiar with the learning outcome types.

Reiser, R. A. & Gagne, R. M. (1983). Selecting Media for Instruction. Englewood Cliffs: Educational Technology Publications.

Smith, P. L. & Ragan, T. J. (1999). Instructional Design. New York: John Wiley and Sons.

Step 4. *Help the faculty member to determine which instructional methods may be appropriate for the learning outcome.*

Next you will introduce the concept of instructional methods to the faculty member. Your purpose in this step is to enable the faculty member to visualize options for how material can be presented on the web to effectively fulfill learning outcomes. You want to familiarize the faculty member with the various methods and have him or her select all that may apply. As you go through this step, keep a record on the Tracking Form of all of the methods that may apply. As you present the alternatives, be prepared to answer questions and brainstorm with the faculty member. The learning outcome type that you identified in the last step provides a basis for your discussion here.

Then you'll summarize the results of your discussion pointing out the methods that were suitable and the reasons why. Explain that it may not be possible to find online resources to execute these methods for the given learning outcome, but that the process of having thought through possible solutions should be helpful. At the end of this step, show the faculty member the *Table of Learning Types And The Instructional Methods Most Commonly Used For Them* to tie together the last two steps. The following supplementary material is an expanded description of the types of instructional methods.

Supplementary Material – Instructional Methods*

An instructional method, also known as a strategy, identifies a type of instructional process. This process has general characteristics that specify how information gets from the instructor to the learner and how the learner interacts with and uses that information (Romiszowski, 1988). Some instructional methods are more appropriate for certain types of learning than others. The instructional methods listed here are effective in a web-based environment and capable of being implemented or enhanced through the use of online resources.

- Drill and practice – Learners are led through exercises to gain proficiency in lower order skills and in their ability to automatically recall information. Drill and practice is suitable for any application that might otherwise utilize worksheets. This method is appropriate for tasks that require memorization and recall such as learning arithmetic tables and foreign language vocabulary and gaining keyboard proficiency. These activities can provide the rehearsal needed to transfer newly learned information into long-term memory. Drill and practice is particularly helpful for the learning outcome type of *verbal information*.
- Game – A game is an exercise in which the objective is to win and the player must apply knowledge to do so. A game transports the student to another setting and requires an active response. A game may fulfill a number of learner purposes including allowing for practice of knowledge and skills; identifying skills that need to be learned; providing a review, a reward or change of pace; and providing the opportunity to practice familiar skills in an unfamiliar context. Games may require learners to use problem solving skills or to supply content with a high degree of accuracy.

The methods section has been adapted primarily from Dabbagh and Bannan-Ritland (2005), Roblyer (2004) and Smaldino, Russell, Heinich, & Molenda (2005) with most information on simulations and games from Gredler (2004). Gredler's article is available online free of charge to AECT members at www.aect.org.

Games need to be examined carefully before use. Many games are not well designed, and they may contain violence and/or require so much manual dexterity that they can be frustrating.

Well designed games tend to be appropriate for *verbal information* and for some *intellectual skills*.

- Simulation – A simulation is a case study of a specific reality, social or physical, with which the student interacts and learns as a result of that interaction. In a simulation, different events occur as a result of the actions of the learner. For a simulation to be an effective teaching tool, it must have the following characteristics: it must present a true-to-life model of a situation with a well-defined role for learners with responsibilities and limitations, it must provide a data–rich environment allowing students to execute a range of strategies, and it must provide feedback to learners in the form of changes in the model that result from their actions.

  The learner role in relation to a simulation can be one of two types:

  - A functional part of the system in the case of experiential simulations. Experiential simulations are developed to provide experiences in situations that would be impossible to engage in otherwise because of cost, danger or other limiting factor. Within the experiential simulation category, there are social-process, diagnostic, and data management simulations. Simulations that make it possible to prescribe occupational therapy treatment for medical problems and to train pilots and astronauts are some examples.
  - An investigator or troubleshooter functioning independently in the case of a symbolic simulation. A symbolic simulation provides a dynamic representation of the behavior of a system or set of processes. Examples of this type of simulation include a laboratory research simulation.

  Simulations must be very well designed to be effective. Thus they must be monitored carefully for quality. Additionally ***some simulations may require research and discovery learning skills of which the learner may not be capable***. Instructors should carefully analyze the simulation to see whether prerequisite skills must be taught prior to learner engagement.

  Well designed simulations can provide a learning experience unavailable through other means and can bridge the gap between the classroom and the real world. Simulations can be used to compress time, slow down processes, involve students, make it safe to experiment, control uncontrollable situations, make it possible to engage in activities that would not otherwise be possible, and repeat events limitlessly with variations. They can be used to replace or supplement lab experiments, role playing, and field trips.

  Depending upon the design of the simulation, simulations can be appropriate for many different learning outcome types. Some simulations can teach attitude learning, others cognitive skills, and some motor skills. Simulations can also be used to teach many different types of intellectual skills including processes, problem solving, principles and concepts. Additionally, in some cases, simulations can reveal student misconceptions about content and provide information about student problem solving strategies.

- Problem solving – In this method, students are placed in an active role and need to solve a real-world problem. Such exercises are usually presented by dynamic visuals representative of an imagined or real world and other media-rich materials. While this method is similar to a simulation in that it places the learner in an active role with the need to solve a problem, it is different in that it involves one or more well-structured, discrete problems rather than interaction with a complex system in an open-ended exercise. Such a method may involve group processes, facilitation by the instructor, and consultation with other resources via the internet or library.

Like a simulation, the problem solving method may utilize the *role playing* and or/*case study* instructional techniques.

Learning types addressed by this method most often include cognitive and intellectual skills.

- Discovery – This method presents problems to be solved utilizing an inductive approach. In discovery learning, students research questions using a variety of sources, some of which may be new to both learner and instructor. The aim of this method is to allow students to deeply understand content through active engagement with it.

  A *webquest* is one example of discovery learning. In a webquest, the learner is guided in using the web to find information and then focuses upon analyzing, synthesizing, and evaluating the information that is discovered.

  Prior to engaging in this method, students should be knowledgeable in discovery skills, or it can prove burdensome.

  Discovery learning is primarily oriented toward the acquisition of intellectual skills. Through discovery learning, students discover rules, procedures, and other content-related knowledge.

- Presentation – In this method, a wide range of information is disseminated one-way through a medium that can vary from text to audiotape to video to an audiovisual display. Aside from viewing the material, there are no opportunities for learner interaction.

  The presentation method can utilize a case study strategy.

  The presentation method can be used to present a broad spectrum of learning types, but by itself it does not provide the means to either reinforce the learning or assess how effective it has been for the learner.

- Demonstration – This method provides a depiction of a skill or procedure to be learned. A demonstration can consist of the modeling of a desired behavior by an expert. It can occur in the context of a case study. A demonstration can be a one-way communication like a presentation, or opportunities for questions, practice and/or feedback can be incorporated.

  The Demonstration method is most commonly used for attitude, motor and intellectual skills acquisition.

- A dialogic learning environment (Dabbagh and Bannan-Ritland, 2005) is a method that assists learners in constructing new knowledge through social interaction using web-based technologies. These technologies include synchronous and asynchronous mechanisms such as forums, e-mail, document sharing and virtual chat. Learning resources, either supplied by the instructor or found by the student, can be part of this environment.

  This method promotes learner articulation, reflection, and collaboration, activities that can be associated with the acquisition of intellectual, cognitive and attitude learning types.

Dabbagh, N. and Babban-Ritland, B. (2005). Online Learning: Concepts, Strategies, and Application. Upper Saddle River, NJ: Pearson Prentice Hall.

Gredler, M. E. (2004). Games and simulations and their relationships to learning. In Jonassen, D. H. (Ed) Handbook of Research on Educational Communications and Technology (2nd Ed), pp. 571-581. Mahwah, NJ: Lawrence Erlbaum Associates.

Roblyer, M. D. (2004). Integrating Educational Technology into Teaching. Upper Saddle River, NJ: Pearson Prentice Hall.

Romiszowki, A. J. (1988). The Selection and Use of Instructional Media. London: Kogan Page.

Smaldino, S. E., Russell, J. D., Heinich, R., & Molenda, M. (2005). Instructional Media and the New Technologies of Instruction. Upper Saddle River, NJ: Pearson Prentice Hall.

Table of Learning Types and the Methods Most Commonly Used for Them

Psychomotor	**Attitudes**	**Cognitive**	**Verbal**	**Intellectual**	**Miscellaneous (aesthetic)**
simulation	simulation	simulation	drill-and-practice	simulation	presentation
presentation	presentation	presentation	presentation	presentation	demonstration
demonstration	demonstration	demonstration	games	demonstration	discovery
case study	case study	case study		case study	
role play	role play	role play		role play	
	dialogic	dialogic		dialogic	
		problem solving		problem solving	
				discovery	
				games	

Step 5. *Select some potential media formats on the basis of the attributes needed to fulfill your learning outcome.*

In this step you will review the learning type that you have identified for the learning outcome and the potential methods that you have identified. From there you can identify some potential media formats that can fulfill your learning outcome. To do so, refer to the two tables that follow, (1) the *Table of Learning Types and the Media Most Commonly Used for Them* and (2) the *Multimedia Heuristic Guide.*

These tables present media attributes relevant to the various methods and learning outcome categories. Media attributes are the affordances that different media provide to clearly deliver various kinds of instructional messages and to verify that learners have learned that content (Romiszowski. 1988). Media attributes should be thought of functionally, that is, whether they are capable of providing the kind of stimuli necessary to communicate a specific kind of message clearly and if they can accommodate student responses. For example, visuals can provide a more concrete referent for words, helping to avoid misunderstandings. Motion media and sequential stills can be used to display a process. Media can also be used for evaluation; students can be asked to identify objects in photographs, listen to a symphony in audio and identify the movements, or describe how they would respond to a situation depicted in a video.

Some media attributes are *instructional,* and some are *physical.* Instructional media attributes can be determined by how the media supports the type of performance expected of learners as a result of the instruction. Media differ in their ability to support various types of expected performance. For example, when concepts involving spatial relationships are being learned, pictures are a much more effective medium than verbal descriptions.

On the other hand, the physical attributes of media are the physical aspects of communication that the media are able to display, for example, visual displays make it possible to teach concrete concepts, such as shapes and objects and spatial relationships such as locations and distances. The script directs you to use those charts to isolate and extract the information related to these two kinds of media attributes that apply to the faculty member’s learning outcome.

Base your decision on whether a resource is appropriate for the curriculum at least partially on your knowledge of the instructional attributes of various media and how they link to different learning outcome types. The following *Multimedia Heuristic Guide* provides that information and includes examples of the instructional attributes of the various media types.

Make sure that you thoroughly understand the information in the *Multimedia Heuristic Guide* so that you can properly guide the discussion. Following that is some additional background information on the various media types and their attributes. Use this narrative information if you wish to gain an even more solid understanding of media and their attributes.

After looking at these tables, take a 15 – 20 minute break to let the faculty member clear his or her head from all the input.

Romiszowki, A. J. (1988). The Selection and Use of Instructional Media. London: Kogan Page.

Table of Learning Types and the Media Most Commonly Used for Them

	Text	**Audio**	**Anima-tion**	**Video**	**Photos**	**Draw-ings**	**Graphics**	**Dia-grams**	**Audio & Visuals***	**Text& Visuals**	**Audio & text**	**Audio & Visuals* & Text**
Psychomotor		X		X					X			
Attitudes	X	X		X	X				X			X
Cognitive				X					X			X
Verbal	X	X	X	X	X		X	X		X	X	
Intellectual	X	X	X	X	X		X	X	X	X	X	X
Miscellaneous (aesthetic)	X	X		X					X			X

*Visuals here generally consist of photos, simple animation or line drawings with arrows.

Multimedia Heuristic Guide Page 1

(For Psychomotor, Attitudes, and Verbal Learning Outcome Types with Selected Media Types)

	Text	Audio	Animation	Video	Photos	Drawings	Related Media Issues
Psychomotor Learning		*Can guide learning of motor skills* *Can teach verbal and musical components, allowing for practice*		*Can display physical skills and allow repeated viewing and practice*	*Can show position of people and things in motion*		
Attitudes Learning	*Compelling text can teach attitudes*	*Use of the voice of an admired, recognizable role model can be effective as can background music, sound effects & narration*		*Dramatic reenactments can change attitudes* *Can promote cultural understanding through showing other ways of life*	*Photos of people can change attitudes.*		
Verbal Learning	*Can be most efficient medium for good readers*				*Can illustrate concepts and aid retention* *Can identify people, places & things.*		*Provide opportunity for practice and feedback*
Related Learning Outcome Issues	*For memory support, leave information to be memorized on screen as text.*	*Make sure that audio segments can be replayed and replayed at reasonable intervals; Some students have a hard time learning from audio*	*Animations should be assessed carefully for potential cognitive load problems.*	*Video can be effectively replaced online with still photos, line drawings with arrows & simple animations supported by audio; assess video applications individually for problems*	*A multi-image presentation using 2 or more simultaneous photos to compare visual phenomena can be effective for different purposes*	*Can be better than photos because detail can be minimized or maximized through callouts.*	

Multimedia Heuristic Guide Page 2

(For Intellectual and Aesthetic Learning Outcome Types with Selected Media Types)

	Text	Audio	Animation	Video	Photos	Drawings
Intellectual Learning	*Can teach concepts and rules and fulfill other intellectual learning outcomes*	*Can guide learning of intellectual skills* *Dramatic audio segments can be used to introduce problems* *Can teach recognition and discrimination of audio stimuli*	*Can be used to simplify rapid and complex processes and to manipulate time & space*	*Can portray procedures and case studies* *Can show things too dangerous to see otherwise* *Teaches recognition & discrimination of relevant motion stimuli, teaches rules, principles, & models performance especially with human interaction*	*Can be used to teach processes*. *Can point out critical differences between objects & exaggerate differences* *Can identify people, places & things*	*Can display facts related to forms, equipment, computer screens & information invisible to the eye,* *Can show principles of operation of objects with working parts enclosed* *Can display critical differences among objects*
Aesthetic (miscellaneous) Learning		*Can be used for stories, poems, & oral histories*		*Can present artistic performances and storytelling and manipulate space & time*		
Related Learning Outcome Issues	*For memory support, leave information to be memorized on screen as text.*	*Make sure that audio segments can be replayed and replayed at reasonable intervals* *Some students have a hard time learning from audio*	*Animations should be assessed carefully for potential cognitive load problems*.	*Video can be replaced online with still photos, line drawings with arrows & simple animations supported by audio; assess online video applications individually for problems*	*A multi-image presentation using 2 or more simultaneous photos to compare visual phenomena can be effective*	*Can be better than photos because detail can be minimized or maximized through callouts.*

Multimedia Heuristic Guide Page 3

(For Psychomotor, Attitudes, Verbal and Intellectual Learning Outcome Types with Other Selected Media Types)

	Graphics	Diagrams	Audio with Visuals	Text with Visuals	Audio with Visuals & Text	Related Media Issues
Psychomotor Learning				*Drawings and photos can be sequenced to show steps in psychomotor skills.*		
Attitudes Learning			*Graphics could be effective*			
Verbal Learning	*Depicts concepts, phenomena, trends*	*Multi-Image diagram could show schematic next to actual components*		.	*Animation with audio can replace video.*	*Provide opportunity for practice and feedback*
Intellectual Learning	*Depicts processes, concepts, rules, phenomena, trends, interrelationships*	*Good for concepts, rules & can illustrate relationships.* *Multi-Image diagram could show schematic next to actual components*	*Diagrams good*	*Diagrams good/animated color diagrams with text can describe processes and tell how something works* *Drawings & photos can be sequenced to teach principles & show position of objects in motion or when being manipulated*	*Animation with audio can replace video*	*Animation with audio can replace video*
Related Learning Outcome Issues	*Graphics = graphs and charts. Graphs are a visual rep. of numerical data, charts a visual rep. of abstract concepts like org charts and time lines*	*Diagrams = visuals aiming at a clear depiction of an object or characteristics of an object, such as schematics, or flow diagrams*				

Background Information on Media

Text Text can be the most efficient medium for conveying verbal information to good readers online. The intellectual skills of concepts and rules may also be easily learned from printed text. With concepts and rules, providing opportunities for practice and feedback is necessary. Depending upon the content, text can sometimes be effective at teaching content in the Attitude learning outcome category. For memory support, e-Learning information that must be memorized should be presented as text that remains for a while on the screen rather than as audio that is transitory.

Audio Media. Audio can record and transmit the human voice and other sounds for educational purposes. It can be used for stories, poems and music as well as oral histories. Students can record themselves for evaluation by the instructor. Audio has many advantages for learners who do not read or do not read well. The downside of audio is that some students find it hard to attend to and/or understand instruction delivered via audio. It is important when placing audio on the web to make sure that the student can replay it and to replay it at reasonable intervals.

Audio can be a good medium though which to teach verbal information and to guide the learning of intellectual and motor skills. Making use of the voice of a recognizable and admired role model is an effective way to establish attitudes. Introducing problems through dramatic audio segments can also be effective. Audio can be useful in teaching recognition and discrimination of relevant audio stimuli such as music. Audio can be used to teach verbal and musical skills for psychomotor learning, making it possible for students to hear, imitate, and practice such skills. The use of background music, sound effects and narrator's voices can result in affective outcomes in the attitude domain.

Audio combined with other media rather than by itself is most effective for many educational purposes. Audio is most effective when the information it is providing is different but complementary, rather than the same, as the information being provided by visual elements. Supplementing audio with printed matter and still visuals is effective for teaching rules and principles. Supplementing audio with printed materials enabling student response and corrective feedback is effective for teaching intellectual skills.

Video. Video is especially effective for portraying procedures and displaying physical skills, enabling mastery and emulation through repeated viewing. Motion can be exaggerated fast or slow to aid understanding. Video can promote cultural understanding through depicting other ways of life and can change attitudes through dramatic recreations, particularly though showing choices made by human models. Video can be used to display phenomena that would be dangerous to view directly and allows for manipulation of space (seeing things from different points of view) and time (through the use of time lapse).

Video is effective at teaching recognition and discrimination of relevant motion stimuli. It can be used to teach rules and principles and model performance, especially in situations requiring human interaction. Video is useful in the *affective* learning outcomes area for creating attitudes and emotion through various techniques. When combined with print requiring learner response, video is good for *intellectual* and *motor skills*.

Video is good for storytelling, case studies and for capturing the real world. Video can be effectively (and economically) replaced online with still photos, line drawings with arrows and simple animations supported by audio. Because of the current technical difficulties in presenting video on many computer systems, online resources consisting of or containing video should be assessed individually to ensure that they meet the potentials of the video medium described here.

Animation. Animation is a medium in which motion has been given to an otherwise inanimate object. Animation makes it possible to manipulate time and space and to simplify complex and rapid processes. Animation excels at communicating the abstract and the conceptual, for communicating meaning without getting lost in detail, in contrast with video that excels at capturing the real world. Animated color diagrams supplemented by text can be used to describe processes telling how something works. Animation supplemented by audio can effectively replace video. Animation should be carefully assessed for potential cognitive load problems.

Visuals. There are a number of different kinds of visuals that serve different instructional purposes. They include

- Photographs
- Drawings

- Diagrams
- Graphics (including charts and graphs)

Photographs. Photographs can be used to illustrate certain content areas that will benefit from visual amplification. Photographs can be helpful in the study of processes and in achieving outcomes in which identification of people, places or things is necessary. Photos can be useful with outcomes in the verbal information category to illustrate concepts, thereby aiding in retention. Attitude learning outcomes can be achieved through photos of people. Intellectual learning outcomes can be accomplished with photos by pointing out critical differences between objects and by exaggerating differences that might otherwise be overlooked. Photos can also be used to present a multi-image presentation online, using two or more photos simultaneously. Two or more photos can be used to compare and contrast art work or other visual phenomena or to present an overview or wide shot of a visual while the other(s) show a close up or detail view.

Drawings. Drawings can display many of the same representational qualities as photos, but the fact that a drawing's detail can be more or less pronounced can make it more useful than a photo. Concrete facts such as forms, computer screens and equipment are better expressed through simple line diagrams than photos because photos can have too many extraneous details. When more detail is needed, callouts or a linked table can be used with a simpler drawing.

A drawing can display information that is not visible to the eye and thus cannot be displayed through a photograph. Certain intellectual learning outcomes can be achieved through displaying the principles of operation of objects that normally have their working parts enclosed and through showing critical differences among objects and exaggerating differences in objects that might otherwise be overlooked.

Photos and drawings have some effectiveness for psychomotor learning outcomes by showing the positions of people or things in motion. When supplemented by text, drawings and photos have greater capabilities. They can be sequenced to teach principles or steps in psychomotor skills and to show positions of objects in motion and/or when being manipulated. Photos and drawings can achieve verbal and intellectual learning outcomes through providing factual information, presenting vocabulary, providing directions, and describing work flow.

When supplemented by audio, sequentially presented drawings and photos can be used for the same purposes as video but for much less cost The capabilities of such visuals may be somewhat diminished in that they don't move, can't provide as many distinctive cues, can't elaborate verbal information as well, nor can they display the same degree of realism. However, they are capable of elaborating verbal information, resulting in verbal outcomes, they can present human models and their actions for attitude outcomes, and they can provide cues to distinguish visual tasks for intellectual outcomes. Such materials are also excellent for achieving psychomotor outcomes.

Diagrams. Diagrams are visuals aiming at a clear depiction of an object or specific characteristics of an object such as cross sections, schematics, engineering drawings and flow diagrams. Diagrams are well adapted to helping learners achieve intellectual outcomes, particularly concepts and rules, because they can give emphasis to distinctive visual elements and provide analogies to clarify the relationships among topics being taught. They can convey the meanings of more abstract meanings and rules through illustrating the relationship among concepts. For such learning to be effective, students have to be provided with a way to demonstrate and get feedback on what they have learned. Diagrams can also be used effectively to reinforce print or audio narrative to teach intellectual outcomes including rules, principles, and concepts. An appropriate diagram can be used as part of a multi-image visual presentation, for example, to show a schematic of components next to the actual components. Such a visual could result in intellectual or verbal learning outcomes.

Graphics. The category of graphics consists of graphs and charts. Graphs provide a visual representation of numerical data while *charts* are visual representations of abstract concepts such as organizational charts, time lines, and flowcharts. The purpose of both graphs and charts is to depict processes, concepts, rules phenomena, trends, interrelationships or a set of figures. These correspond primarily to intellectual and verbal learning outcomes. They can be most effective when supplemented by opportunities for students to demonstrate and receive feedback on what they have learned. visuals can be especially effective when supplementing written or audio narrative. When combined with applicable audio, such materials can effectively achieve learning outcomes in the attitude area.

Step 6. Provide a small lecture/demonstration of various multimedia formats and their uses

Click on each URL and when it displays, demonstrate how the application works and read the narrative from the script.

Take some time to familiarize yourself with the demonstration prior to delivering it. The point of this lecture/demonstration is to expose the faculty member to features of the media and methods that you have just discussed so that they can visualize how they can be used in their own classes. While the script directs you to present the learning objects and resources at the URLs, feel free to encourage on-topic discussion and curriculum-related ideas initiated by the faculty member. If you have set the wheels in motion for faculty member "aha" moments, then your demonstration has been a success.

Some logistical suggestions for presenting the demo – If you will be visiting the faculty member in his or her office, prior to the demo send an email with the URLs necessary for the demo and the search step below so that you can simply paste them into the browser. Also make sure to advise the faculty member of any necessary software including RealPlayer to view the demo applications to make sure that they will be loaded on the computer that you will be using.

In the last step of the demonstration, you will demonstrate an interesting application, the Virtual Piano, that could result in excessive cognitive load for some learners, especially if they are unfamiliar with the content. Use it to segue into a discussion of cognitive load issues.

Step 7.

You will start this step by searching together with the faculty member with the goal of finding one or two usable online learning resources. Searching is iterative, and you may experience some barren and discouraging times. However, if you follow the following process, you have a good chance of finding some useful resources for the faculty member. Plan to spend around an hour in the following search process after you are experienced with it. (Alternatives that may prove more appropriate in some situations are to provide search tips to the faculty member enabling him or her to search independently or as an instructional designer to do a solo search and develop a report. However, those options are not dealt with explicitly in this process script as the purpose of this process is to empower the faculty member with the knowledge to eventually search for online learning resources and objects for him or herself.) You can always supply the FM with URLs so they can continue the search independently. Before you present this process step, make sure to familiarize yourself with the repositories and search engines listed here.

(If you are visiting the faculty member in his or her office, make sure to have him or her bookmark the candidate websites that you discover. If working in your office, send the faculty member away with a list of URLs and/or email the list.)

1. You should have the information you need at this point to define the Search Question with the terms you will need. You may want to think further about synonyms for the concepts that you have identified and how you might narrow or broaden the topic. Use Roget's Thesaurus http://humanities.uchicago.edu/orgs/ARTFL/forms_unrest/ROGET.html if needed.*

2. As appropriate, introduce the faculty member to several useful repositories including Merlot, Academic Info, American Passages, Library of Congress, and Google Images (find the URLs for each below.)

3. Next you'll do your search. Go directly to the learning object repository that seems most appropriate from those listed below:

- The previously discussed Merlot http://www.merlot.org/Home.po that contains many peer-reviewed learning resources that have been developed and contributed by other instructors.
- the digital library collection at Academic Info http://www.academicinfo.net/digital.html

If you do not find what you need at either of these sources you will want to broaden your search, perhaps utilizing the image search (advanced option) in GOOGLE images (http://www.google.com/). Other possibilities are:

- *American Passages: A Literary Survey (Annenberg/CPB)*
  http://www.learner.org/amerpass/slideshow/archive_search.php
  for various images, sound clips, text, and primary sources related to history and American literature or
- Library of Congress
  http://www.loc.gov/
  for visual, audio and textual artifacts from the Library of Congress Collection and links to digital collections around the world.

If you still haven't found what you need, a tutorial at http://www.lib.berkeley.edu/Help/search.html offers information about ways to work with several other search engines. The following chart contains some terms that you may want to use as you search for multimedia. If you used GOOGLE Images Advanced Search, for example, you could put your content term into “related to all of the words” or “related to the exact phrase” and then a number of the following terms (all of those that you might find useful) into the “related to any of the words” section”.

You may also want to use “higher education” as a search term as well as the names of any of the methods that you have identified as potentially useful. You may also want to utilize links from any good resources that you do find. If you are still coming up short you may want to ask the faculty member to ask colleagues in their discipline if they are aware of any good online resources. This can be especially helpful if they belong to a LISTSERVE.

Multimedia Searching Terms
By Steven Smith, Manager of Instructional Media at Portland Community College

Audio Terms	Image Terms	Simulation	Video Terms
au	art	Flash	avi
.au	bitmap	.swf	.avi
audio	bmp	animation	.mov
av	.bmp	java	.mpeg
.av	camera	javascript	.mpg
band	cartoon	"gif animation"	Realmedia
cd	gallery	media	clip
concerts	gif		clips
lyrics	.gif		drivers
multimedia	image		mjpeg
music	images		mov
noise	jpeg		movie
song	.jpeg		movies
sound	photo		mpeg
sound card	photos		mpg
sound cards	photographs		plugins
soundblaster	photograph		quicktime
sounds	pic		video
soundwave	pics		viewers
speakers	pcx		media
track	.pcx		
vocals	.pic		
wav	.pics		
.wav	picture		
	pictures		
	png		
	.png		
	tif		
	tiff		
	.tif		
	.tiff		
	Digital		

As you search, you may come across many resources that may prove useful to the faculty member. Keep track of them all by having the faculty member bookmark them in his or her office or by keeping a list of URLs for the faculty member when using your office. Make sure to evaluate only one or two online resources in each session. Select these on the basis of how well they meet the faculty member's initial criteria.

Step 8. Evaluate the Online Resources that You've Found.

You will be assessing one or two online resources that have been discovered to determine their overall quality and suitability for the faculty member's class. To do so, you will lead the faculty member in determining whether the online resource meets the following criteria. Start by introducing the criteria.

1. Does the resource fulfill some or all of the learning needs discovered in the learning outcome task analysis? Is there a way to compensate for any needs that it doesn't fulfill?

2. Does the resource have the appropriate instructional attributes and physical attributes to elicit the learning outcomes as needed?

3. If applicable, does the resource accept student input in a manner that appropriately demonstrates his or her knowledge?

4. Is the resource appropriate for the learner as specified in the learner analysis?

5. Is the resource credible?

6. Will the resource have longevity as a link on the web or will a request need to be made to download it onto a server?

7. Will the resource place an acceptable amount of cognitive load on the learner? Is the resource compatible with Fleming and Levie's findings and Mayer's multimedia principles for instructional message design?

Fleming and Levie's Instructional Message Design Principles and Mayer's Principles of Multimedia and Cognitive Load

Consider whether the resource is presented in such a way that it is easy to process. When too many different kinds of information are presented either visually or aurally, it can result in so much cognitive load that it is hard for the learner to understand. Fleming and Levie (1993) and Mayer (1999)* have published findings related to cognitive load. Does the online resource conform to the following principles?

Selected Findings of Fleming and Levie Related to Instructional Message Design

9. About seven items can be perceived at a glance in a familiar object, and about seven familiar items can be stored in memory. Does the resource tax these limits?
10. Attention can be elicited through the use of directions such as "look", "listen", "notice", and by asking questions and posing problems. Does the resource contain such scaffolding, or can you easily supply it?
11. By grouping message elements in chunks, comprehension can be facilitated. For example, three strings of three digits each is much easier to perceive than a string of nine digits.

    If there are numerous elements, have they been arranged appropriately spatially or ordered temporally?
12. Does the resource contain difficult concepts? If so, they should be broken into small, relatively easy steps.
13. Are there many elements to attend to? Presented elements should be limited to those necessary to fulfill learningoutcomes.

*Fleming, M. & Levie, W. H. (1993). *Instructional Message Design: Principles from the Behavioral and Cognitive Sciences*. Englewod Cliffs: Educational Technology Publications.

Mayer, R. E. (1999). Multimedia aids to problem-solving. *International Journal of Educational Research*, 31(7), 611-623.

14. Does the resource present objects? If so, the size of any unknown objects should be compared to the size of a known one.

15. Consider that attention is elicited by changes in the features (such as color, movement, and shape) of materials being presented. Does the resource contain such changes within itself or in relation to the instructional context in which it will be presented? Do these changes direct attention to the most relevant ideas in the message?

Mayer's Principles of Multimedia and Cognitive Load

Mayer (1999) discovered that the following multimedia features result in better learning. Consider whether they are true of the learning resource being considered.

- When learners receive words and corresponding pictures rather than words alone (multimedia principle)
- When words and corresponding pictures are presented near rather than far from each other on the page or screen (spatial contiguity principle)
- When words and corresponding pictures are presented at the same time rather than at different times (temporal contiguity principle)
- When words are presented as narration rather than as on-screen text (visual split-attention principle) (Note, however, that accompanying visuals with auditory information is not always most effective cognitively. At times, text words – such as mathematical formulas or directions – are needed by the learner for memory support.)
- When concurrent non-verbal auditory information is minimized rather than maximized (auditory split-attention principle)
- When alternating visual and verbal information is presented in short rather than long segments (chunking principle)
- When extraneous material is eliminated rather than included (coherence principle)

8. Is the resource compatible with findings related to media attributes contained in the *Multimedia Attribute Heuristic Guide?*

9. If there is a choice among resources, have you acknowledged the need to accommodate various learning styles by choosing the resource that will add the most diversity to your instruction?

10. Is the online resource affordable?

Apply these criteria one by one to the resource that you have chosen as your top candidate(s). If there is time, you can go through the evaluation process with another online resource. On the Tracking Form, you should have specified some answers for the questions in Criteria 1 -3. Revisit these answers with the faculty member to see whether the resource meets the needs specified there. For Criteria 4, Appropriateness for Learners, refer to the Learner analysis with the faculty member, and ask him or her whether the resource is compatible with the learner qualities stated there. For Criteria 7, let the faculty member determine whether the resource's cognitive load is acceptable after reviewing the instructional message design principles. If unsure, the instructor might want to do some informal usability testing of the resource with some typical students. For Criteria 8, refer to the appropriate section(s) of *The Multimedia Attribute Heuristic Guide* and confer with the faculty member about whether the resource's multimedia elements should work well according to the guide. For Criteria 10, if price is an issue, ask the faculty member whether the resource will fit into his or her budget.

End the meeting by summarizing what was accomplished and making sure that the FM has what he or she needs to continue with the search if applicable. It should also be stated that if a potentially useful learning object was identified but not discovered in the search, options can be explored for finding if the environment offers funding to develop such a resource.

Appendix L

ORSIDS Summative Evaluation Questionnaire

Name______________________ **Date__________________________**

I. Check the number that best describes the degree to which you think ORSIDS achieves the following goals.

4 It achieves it.
3 It achieves it but would benefit from minimal revision.
2 It partially achieves it but could use substantial revision.
1 It does not achieve it.

Enhancement of pedagogical skills of online faculty 1__ 2__ 3__ 4__

Write any additional comments here. Feel free to continue on another page.____
____

More effective use of college-employed instructional designers 1__ 2__ 3__ 4__

Write any additional comments here. Feel free to continue on another page.____
____

Educator adoption of online resources 1__ 2__ 3__ 4__

Write any additional comments here. Feel free to continue on another page.____
____

II. Check the number that best describes the degree to which you think ORSIDS achieves each of the following standards for the specified requirements. Refer to the "explanationreview" file titled **Abbreviated Validated Requirements** for information about ORSIDS' implementation of the requirements.

4 It achieves it.
3 It achieves it but would benefit from minimal revision.
2 It partially achieves it but could use substantial revision.
1 It does not achieve it.

A. For Requirements 1 – 3 (Input Requirements)

Accuracy of content	1__	2__	3__	4__
Appropriateness of content	1__	2__	3__	4__
Usability of content	1__	2__	3__	4__
Lack of bias	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirements 1 – 3. Feel free to continue on another page. ____
____
____

B. For Requirements 4 – 6 (Learning Outcome Analysis Requirements)

Accuracy of content	1__	2__	3__	4__
Appropriateness of content	1__	2__	3__	4__
Usability of content	1__	2__	3__	4__
Lack of bias	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirements 4 – 6. Feel free to continue on another page. ____

____

____

C. For Requirements 7 – 10 (Research and Gather Online Resource Requirements)

Accuracy of content	1__	2__	3__	4__
Appropriateness of content	1__	2__	3__	4__
Usability of content	1__	2__	3__	4__
Lack of bias	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirements 7 – 10. Feel free to continue on another page. ____

____

____

D. For Requirements 11 – 21 (Learning Resource Evaluation Requirements)

Accuracy of content	1__	2__	3__	4__
Appropriateness of content	1__	2__	3__	4__
Usability of content	1__	2__	3__	4__
Lack of bias	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirements 11 – 21. Feel free to continue on another page. ____

____

____

E. For Requirement 22 (Output Requirement)

Accuracy of content	1__	2__	3__	4__
Appropriateness of content	1__	2__	3__	4__
Usability of content	1__	2__	3__	4__
Lack of bias	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirement 22. Feel free to continue on another page. ____

____

____

F. For Requirements 23 - 26 (Format Requirements)

Easy to learn	1__	2__	3__	4__
Easy to remember	1__	2__	3__	4__
Efficient to use	1__	2__	3__	4__
Subjectively pleasing	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirements 23 - 26. Feel free to continue on another page. ____

____

____

G. For Requirements 27 - 32 (Reference Materials Requirements)

Accuracy of content	1__	2__	3__	4__
Appropriateness of content	1__	2__	3__	4__
Usability of content	1__	2__	3__	4__
Lack of bias	1__	2__	3__	4__

Write any additional comments here related to the implementation of Requirements 27 - 32. Feel free to continue on another page. ____
____
____

III. Do you agree or disagree with the original validated requirements? Would you add to or subtract any of them?____
____
____
____

IV. Please communicate any specific suggestions for revisions here. Feel free to continue on another page.

Revising ORSIDS in the following way would improve its implementation of Requirement ___:
____
____
____
____

Revising ORSIDS in the following way would improve its implementation of Requirement ___:
____
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____
____

Revising ORSIDS in the following way would improve its implementation of Requirement ___:
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Revising ORSIDS in the following way would improve its implementation of Requirement ___:
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____

Revising ORSIDS in the following way would improve its implementation of Requirement ___:
____
____
____
____

V. Provide any additional feedback here.____
____
____
____
____
____
____
____

VI. Continuation page (add more if needed).

Appendix M

The Expert Panel, Expert Advisors, and Expert Interviewee

The Exert Panel was comprised of three members. Dr. Barbara Lockee is an associate professor of instructional technology at Virginia Tech who specializes in instructional design for distance learning as well as media studies. She has edited a book and authored numerous peer reviewed articles and several book chapters. She has just completed a year of service as president of the AECT Research and Theory Division. The other two panelists are employed as instructional technologists. One of them, Shawn Foley, recently finished five years of work in online faculty development at Penn State University and has recently taken a corporate instructional technologist position. Dr. Doris Bolliger is an Assistant professor at St. Cloud State University where she teaches courses in instructional design and multimedia design and assists faculty with the development of their online courses. All three panelists have published in peer reviewed journals and are currently working or have worked as instructional design faculty. Foley is currently enrolled in a PhD program; the other two panelists have completed their doctoral work in Instructional Design. The Expert Panel members participated in criteria validation and summative evaluation of the product.

In addition, the project had two Expert Advisors. Dr. Stephen Gance is an instructional design consultant who has served as an instructional technologist at Portland State University assisting with online faculty development. He is also a past assistant professor of instructional design. Dr. Michael Keppel is an experienced instructional designer who currently is Principal Lecturer and Head of the Centre for Integrating

Technology in Education at the Hong Kong Institute of Education. He has written numerous peer reviewed articles pertaining to instructional design processes and instructional designer/faculty relationships.

The Expert Interviewee was Steve Smith, Manager of Instructional Media services at Portland Community College. In this capacity he assists online faculty with the selection of their online resources for their classes.

Appendix N

IRB Approval Form

Date: Sat, 16 Oct 2004 20:00:06 -0400 (EDT)
From: James Cannady <jcannady@starband.net>
Reply-To: James Cannady <jcannady@starband.net>
Subject: IRB Approval
To: deborahc@nova.edu

After reviewing your IRB Submission Form and Research Protocol I have approved your proposed research for IRB purposes. Your research has been determined to be exempt from further IRB review based on the following conclusion:

Research using survey procedures or interview procedures where subjects' identities are thoroughly protected and their answers do not subject them to criminal and civil liability.

Please note that while your research has been approved, additional IRB reviews of your research will be required if any of the following circumstances occur:

1. If you, during the course of conducting your research, revise the research protocol (e.g., making changes to the informed consent form, survey instruments used, or number and nature of subjects).

2. If the portion of your research involving human subjects exceeds 12 months in duration.

I have attached an approved NSU letterhead for your research in case you need it. Please feel free to contact me in the future if you have any questions regarding my evaluation of your research or the IRB process.

Dr. Cannady

James Cannady, Ph.D.
Associate Professor
Graduate School of Computer
and Information Sciences
Nova Southeastern University

Appendix O

IRB Informed Consent Form

Institutional Review Board for Research with Human Subjects (IRB)

Adult/General Informed Consent form for Participation in *A Process Script for Online Resource Selection Study*

Funding Source: None.

IRB approval # (Generated by IRB)

Principal investigator(s)
Name

Deborah "Sunny" Cohen
Complete mailing address

3627 SW Troy St.

Portland, Oregon 97219
Contact phone number

(503) 285-2614

Co-investigator(s)
Name
Complete mailing address
Contact phone number

Institutional Review Board
Office of Grants and Contracts
Nova Southeastern University
(954) 262-5369

Description of the Study:

The purpose of this study will be to develop a process "script" to assist college-employed instructional designers in guiding faculty with selecting online media and multimedia resources for their online courses. The study will result in a script that will make it possible for instructional designers and online faculty members to work together effectively and to efficiently evaluate online resources for a given course. It will expand faculty member knowledge of course design as they become familiar with the prescribed multimedia selection techniques. And it will potentially assist with the diffusion of the innovation of learning objects and other online resources into the educational environment.

While scripts are rarely discussed in the instructional design literature, in practice most instructional designers rely upon them to do their jobs. Scripts simplify communication between the instructional designer and subject matter expert. Such scripts provide a "shortcut" for the instructional designer in his or her work, making it possible to accomplish goals while using less of the subject matter expert's time. As the development process for higher education courses containing new media can be even more complex than traditional courses and the instructional designer workload in higher education has the potential to be more demanding, the need for such scripts becomes even greater.

The script developed in this study will aid the consulting and conceptualization/elicitation process between the instructional designer and online faculty member in the area of the selection of online resources. A script to guide faculty members with the media selection process required to select online *resources will greatly aid the instructional designer in his or her role of change agent diffusing the innovation of learning objects and other online resources.*

This study will utilize a development methodology. The Pre-Design Phase will consist of the review of literature and other information gathering. Establishing formative and summative review committees will also occur in this phase. The Design Phase will consist of criteria development and criteria validation. Members of the expert panel will validate the candidate criteria proposed by the researcher. The beta version of the process script will be designed in this phase.

In the Development Phase, the process script will be further developed and then refined utilizing formative evaluations by several online faculty members. This will make it possible for the investigator to develop the process script using rapid prototyping. It is estimated that the participation of these subjects will consist of two sessions for a total of six hours.

Next, in the pilot study, two instructional designers will be trained on use of the process script. They will use the script with one online instructor each. These sessions will be observed by the investigator who will fill out an observation checklist. The investigator will also videotape these sessions for later review. When the testing session is over, the instructional designers will be given questionnaires to fill out about whether the process script led to a more productive exchange than would have been possible without it. The process script will again be refined on the basis of this testing. The investigator will write reports based upon the observation checklist, the videotaped transcripts, and the questionnaires and include details of the changes that were made to the product on the basis of this input. The pilot study participation of the instructional designers is estimated to be eight hours: one hour to be briefed on the product and its use, two sessions for a total of six hours to work with the online faculty, and one hour to fill out the questionnaire and debrief. The participation of the pilot study online faculty is estimated to consist of two sessions for a total of six hours

Product Validation will be ensured though summative evaluation by the expert panel. In addition to the final process script, the expert panel will receive the investigator reports. The expert panel will compare the final process script to the initial criteria candidates to assess how well the script met the criteria.

Risks /Benefits to the Participant:

The subjects will be exposed to minimal risks through participation in this study. They will engage in the same kinds of routine training activities that they might engage in as part of their everyday activities.

If you have any concerns about the risks or benefits of participating in this study, you can contact Sunny Cohen or the IRB office at the numbers indicated above

There are no direct benefits for participation in this study.

Costs and Payments to the Participant:

There are no costs to you or payments made for participating in this study.

Confidentiality and Privacy

The names of the instructional designers and online instructors who participate in product testing may be made public with their permission. Research records from the formative evaluation and pilot testing will be maintained on the researcher's private equipment in a secure room. When transferring data to Nova Southeastern University and the expert panel, the names of the testers will be absent or coded.

All information obtained in this study is strictly confidential unless disclosure is required by law.

Use of Protected Health Information (PHI)

This study does not require the disclosure of any Protected Health Information

Participant's Right to Withdraw from the Study

You have the right to withdraw at any time. If you choose to withdraw, you may request that any data which has been collected will be destroyed unless prohibited by state or federal law.

Other Considerations

If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you by the investigators.

****
Voluntary Consent by Participant:

I have read the preceding consent form, or it has been read to me, and I fully understand the contents of this document and voluntarily consent to participate. All of my questions concerning the research have been answered. I hereby agree to participate in this research study.

I ______ agree

______ don't agree

to have my name made public in association with the testing this product.

If I have any questions in the future about this study they will be answered by Sunny Cohen. A copy of this form has been given to me. This consent ends at the conclusion of this study.

Participant's Signature:___________________________ Date:___________________
Authorized Representative_________________________Date___________________
Authority of Representative is based on:_______________________________________
Witness's Signature:______________________________ Date: ___________________

Appendix P

Communication to the Expert Panel members

Greetings,

[redacted] –

Thank you so much for offering to serve on the expert panel for my dissertation!!

At this phase I am asking you to validate the criteria that I am proposing for the Online Resource Selection Process Script that I will be developing and testing. On the accompanying pages you will find the criteria to be validated and a description of the project. I am hoping that you can spend some time with them in preparation for our meeting at AECT. I am planning for us to use our time there to engage in a Nominal Group Technique Process to gather your opinions about these criteria (and any others you might have in mind) for the product.

Meeting Time: Friday, October 22, 2004, 1 – 3 PM

Where: Hilton Hotel, Room of [redacted] & Sunny Cohen

Lunch will be provided (can you please email me prior to Monday if you have any dietary restrictions?)

Meeting Agenda

1. Introductions — 5 minutes
2. Questions — 10 minutes
3. Validate criteria — 1 hour 45 minutes

If you can spend some time in advance of the meeting considering the proposed criteria, what you think of them and their importance or lack of it, any rewording you would propose, and any additional criteria that you would suggest, I would really appreciate it. That will help us to use our time more efficiently at the meeting.

Please contact me if you have any questions. I will be leaving for Chicago on Monday and will be away from the phone and email probably Monday and Tuesday but at the conference and the Hilton Hotel beginning on Wednesday. I am looking forward to seeing you!

Thanks again.

Best,

Sunny

Appendix Q

Preliminary Proposal Review Worksheet

Criteria Candidate Validation Worksheet

Strengths of the Criteria	***Modifications Which Would Be Improvements***

Appendix R

Faculty Training Materials

Lesson Plan – Prerequisite Training for Secondary Users of Online Resource Selection Instructional Designer Script (ORSIDS) (adapted from the ASSURE Model by Smaldino, Heinich, Russell & Molenda, 2005)

Concept*	Instructional Strategy	Time allotted
Analyze learners • Can you anticipate who your learners will be?	Ask the question and allow time for discussion	5 minutes
• Introduce the idea of thinking about learners on the basis of general characteristics, specific entry competencies, and learning styles (mention that learning styles will not be explored in depth) • Provide definition of general characteristics, specific entry competencies, and learning styles (based on a summary of the discussion on pages 49 – 52 of Smaldino, Heinich, Russell & Molenda, 2005)	Lecture allowing time for questions and answers	10 minutes
• Ask participants to analyze their learners along these lines and then discuss results briefly	Provide worksheet to be filled out	15 minutes
Introduce the concept of learning objectives (based on a summary of the discussion on pages 53 – 54 of Smaldino, Heinich, Russell & Molenda, 2005) • Definition: what new capability will learners possess at the end of the instruction? • The importance of stating learning objectives	Lecture allowing time for questions and answers	5 minutes
What constitutes a well-stated objective? Can include audience, behavior, performance and degree	Lecture allowing time for questions and answers	10 minutes
Ask participants to write their learning objectives for their course, then discuss	Provide worksheet to be filled out	15 minutes

Learner Analysis Worksheet

My anticipated learners have the following general characteristics (such as age, reading ability, grade level, professional position if applicable, computer experience, any important cultural or socioeconomic factors):

My anticipated learners have the following specific entry competencies:

My anticipated learners have the following learning styles:

Learning Objective Worksheet

As a result of this course, my learners will be able to:

Audience____

Behavior____

Conditions____

Degree____

Learning
Objective:____

As a result of this course, my learners will be able to:

Audience____

Behavior____

Conditions____

Degree____

Learning
Objective:____

As a result of this course, my learners will be able to:

Audience____

Behavior____

Conditions____

Degree____

Learning
Objective:____

Learning Objective Worksheet (Cont.)

As a result of this course, my learners will be able to:

Audience____

Behavior____

Conditions____

Degree____

Learning Objective:____

As a result of this course, my learners will be able to:

Audience____

Behavior____

Conditions____

Degree____

Learning Objective:____

As a result of this course, my learners will be able to:

Audience____

Behavior____

Conditions____

Degree____

Learning Objective:____

Appendix S

ORSIDS Training for Administering Instructional Designers - Lesson Plan

Introduction to the ORSIDS Script and Process, using the *ORSIDS Decision Tracking Form* 10 minutes

Explain the prerequisite training given to faculty members 10 minutes

Questions 10 minutes

For each step of the ORSIDS script below, provide an overview of what is to occur, discuss special issues, entertain questions, explain the Supplementary material, and provide a script demonstration. Use a combination of demonstration, modeling, and text analysis. This portion will take approximately 3 hours with a 20 minute break.

Step #	**Step**	**Supplementary material to be Explained**
1.	Help the faculty member to determine which learning outcomes are good candidates for fulfillment with online learning resources	
2.	Guide the faculty member in doing a task analysis for the specified learning outcome.	*Explanation of Task Analysis*
3.	Help the faculty member to determine the learning outcome category to which the specified learning outcome belongs.	*Learning Outcome Categories*
4	Help the faculty member to determine which instructional methods may be appropriate for the learning outcome.	• *Instructional Method*s • *Table of Learning Types and the Methods Most Commonly Used for Them*
5	Help the faculty member to focus on the instructional and physical media attributes needed by the online learning resource to choose some potential media formats.	• *Table of Learning Types and the Media Most Commonly Used for Them* • *Multimedia Heuristic Guide*
6	Provide a small lecture/demonstration of various multimedia formats and methods and their uses.	• Demo
7	Search together for online resources and provide search tips to the faculty member enabling him or her to continue to search independently.	• *Search Step* • *Multimedia Searching Terms*
8	Evaluate one or possibly two resources for possible use.	*Fleming and Levie's Instructional Design principles and Mayer's Principles of Multimedia and Cognitive Load*

Appendix T

Changes Made to ORSIDS Requirements During Validation

Requirement candidate	Validated requirement	Change
INPUT REQUIREMENTS		
Analysis of learners based upon general characteristics such as age, reading ability, previous experience with subject, previous experience with online learning	**Analysis of learners** based upon general characteristics such as age, reading ability, previous experience with subject, previous experience with online learning, motivation, and relevance of instruction	Addition: "motivation, and relevance of instruction"
A statement of each **learning outcome**, including the following: the audience for whom the objective is intended, the behavior or capability to be demonstrated, the conditions under which the behavior or capability will be observed, and the degree to which the new skill must be mastered	A statement of each **learning outcome**, including the following: the audience for whom the objective is intended, the behavior or capability to be demonstrated, the conditions under which the behavior or capability will be observed, and the degree to which the new skill must be mastered	No change
	Acknowledgment of Context • Task responsibilities – will it be the instructional designer or the faculty member who will ask for copyright permissions and do long term maintenance of the course and related online resources? • What technological capabilities can be assumed on the part of the students' computer equipment? • What computer skills can be assumed on the part of the students? • What skills in online learning and specifically those related to multimedia can be assumed on the part of the students?	These are additional requirements.
Steps in the Process Script		
Decide which learning outcome(s) must be fulfilled with an online resource	Decide which learning outcome(s) (or portions of a learning outcome) should be fulfilled with an online resource because of pedagogical resistance or other reasons	Note verbiage changes
	Do a task analysis for the specified learning outcome.	This is an addition meant to replace the unclear wording in a later requirement: "Choose a media format based on the learning outcome and **conditions of learning necessary to achieve the outcome"**

Requirement candidate	Validated requirement	Change
Determine the learning outcome category to which the specified learning outcome belongs	Determine the learning outcome category to which the specified learning outcome belongs	No change
Then for each selected learning outcome, do the following four steps	*Then for each selected learning outcome, do the following four steps (in any order as appropriate)*	The order of the steps was made optional to reconcile the difference between how the steps are often done in practice with standard ID methodology
	The instructional designer provides a small lecture/demonstration of various multimedia formats and their uses.	This is a new requirement recommended by the expert panel.
Choose a media format based on the learning outcome and conditions of learning necessary to achieve the outcome	Choose a media format based on the learning outcome and learning outcome task analysis results (these media formats will be limited to those commonly found in online resources such as MERLOT.)	In this requirement, the verbiage "conditions of learning necessary to achieve the outcome" is replaced with "learning outcome task analysis results". The media formats to be included is also made more specific with "these media formats will be limited to those commonly found in online resources such as MERLOT."
Survey online learning resources/learning objects	Survey online learning resources/learning objects. This survey can occur in a number of ways. (1) The instructional designer and faculty member search together (2) The instructional designer does the search and prepares a report for the faculty member (3) The instructional designer provides tips to the faculty member to prepare him or her to do the search. In options 1 and 2, the instructional designer time for the search will usually be between 1 and 2 hours. The time spent by the faculty member when pursuing option 3 will be at his or her own discretion.	This requirement was greatly expanded in terms of specificity and process options.
Then select among available resources based upon the following:	*Then select among available resources based upon the following:*	No change
Whether the resource meets the conditions of learning required by the curriculum area	Whether the resource can fulfill the learning outcome task analysis requirements	Note the wording change. As stated previously, this change was meant to make the verbiage less ambiguous.
Whether the resource has the appropriate instructional attributes and physical attributes to implement the learning outcomes as determined by Reiser and Gagne and Romiszoswski.	Whether the resource has the appropriate instructional attributes and physical attributes to elicit the learning outcomes as determined by Reiser and Gagne and Romiszoswski	Word change. "Implement" is replaced with "elicit"

Requirement candidate	Validated requirement	Change
Whether the resource provides the instructional message with the proper stimulus		*Deleted. The task analysis requirement that was introduced was intended to replace this requirement.*
Whether, if applicable, the resource accepts student input in a manner that appropriately demonstrates his or her knowledge	Whether, if applicable, the resource accepts student input in a manner that appropriately demonstrates his or her knowledge	No change
Whether the resource is appropriate for the learner, considering factors such as age and ability to read.	Whether the resource is appropriate for the learner, considering factors such as age, reading ability, previous experience with subject, previous experience with online learning, motivation, and relevance of instruction.	More "appropriateness for learner" factors included. Note verbiage change.
Whether the resource is credible	Whether the resource is credible. (The fact that credibility can be an issue online should be pointed out to the faculty member by the instructional designer. The decision of online resource credibility can then be left to the faculty member.) .	The issue of how to deal with resource credibility was made more specific in the validated requirement.
Whether the resource will have longevity as a link on the web or a request needs to be made to download it onto a server	Whether the resource will have longevity as a link on the web or a request needs to be made to download it onto a server	No change.
Whether the resource places an acceptable amount of cognitive load on the learner	Whether the resource places an acceptable amount of cognitive load on the learner. (What is acceptable can be determined by the instructor after the issue of cognitive load has been explained by the instructional designer. If unsure, the instructor might want to do some informal usability testing of the resource with some typical students.)	The issue of how to deal with acceptable amount of cognitive load was made more specific in the validated requirement.

Requirement candidate	Validated requirement	Change
Whether the resource is compatible with Mayer's multimedia principles for instructional message design.	Whether the resource is compatible with Mayer's multimedia principles for instructional message design. (The instructional designer will present the faculty member with a text list of a summary of Richard Mayer's principles. This list will serve only as a guideline – the faculty member may decide that even if some of the guidelines are not adhered to, the online resource has enough value to be used.)	The issue of how to deal with compatibility with Mayer's multimedia principles for instructional message design was made more specific in the validated requirement.
Whether the resource is compatible with some of the more recent empirical findings regarding multimedia attributes	Whether the resource is compatible with findings related to media attributes including some of the more recent empirical findings regarding multimedia attributes. ("Recent" is defined as recent as of the time of this criteria validation, October 2004. The *Multimedia Attribute Heuristic Guide* will include the attributes from the dissertation Review of Literature and findings from Fleming and Levie (1993), Rouet, Levonen, & Biardeau (2001) and *Learning and Instruction,*Volume 13 (Reimann, 2003). While it will be recommended in Chapter 5 that the guide be updated every two years, such updates will be outside of the scope of this dissertation project.)	This validated requirement is amplified and made much more specific. Fleming and Levie are added as sources, and the recent findings are strictly limited.
	Is the online resource affordable?	New requirement replacing one which asked "whether use of the system will be more …cost effective than conducting the same task without it."
	If there is a choice among resources, has there been an acknowledgment of the need to accommodate various learning styles by choosing the resource that will add the most diversity to the instruction?	This is an added requirement. It resulted from much discussion about the need to acknowledge differences in learning styles with questions about the research on learning styles.

Outp*uts of the Process*

One or more appropriate online resources for each selected learning outcome for utilization in the online course and ultimately evaluation and possible revision.	One or more appropriate online resources for each selected learning outcome for utilization in the online course. (The effectiveness of the online resource will be assessed when the course is evaluated .after course delivery. At that time, revision of the course may include replacing the selected online resource. This action is outside of the scope of this selection process.)	Verbiage added to the validated requirement that more clearly specifies how the online resource will be evaluated.

Requirement candidate	**Validated requirement**	**Change**
The script will consist of text on paper.	The script will consist of text on paper and will include a decision tree. It will be supplemented by demonstrations on the computer for the faculty member by the instructional designer.	Greater specificity is provided for the ORSIDS format in the validated requirement.
It can be copied and used for each new instructional designer/online faculty member online resource selection interaction.	It can be copied and used for each new instructional designer/online faculty member online resource selection interaction.	No change.
It will consist of directions in the second person for the instructional designer, an actual script to be delivered verbatim or improvised form by the instructional designer, worksheets to be filled in and some reference materials.	It will consist of directions in the second person for the instructional designer, an actual script to be delivered verbatim or improvised form by the instructional designer, worksheets to be filled in and some reference materials.	No change.
The process script will be clear, simple, intuitive, easily navigatable, and usable	The process script will be clear, simple, intuitive, easily navigatable, and usable.	No change.
Reference Materials Included with the Script (Note that these materials are written for the instructional designer who may choose to share them with the faculty member)		This note was added for amplification when the requirement was validated.
Searching Tips	Searching Tips	No change
A Cognitive Load and Instructional Message Design Job Aid	A Cognitive Load and Instructional Message Design Text Job Aid	The word “text” was added.
A Multimedia Attribute Heuristic Guide	A Multimedia Attribute Heuristic Guide	No change
	Additional Criterion: A Description of Learning Outcome Categories	Added requirement
	Additional Criterion: Definition of Instructional Methods	Added requirement

Requirement candidate	Validated requirement	Change
	Additional Criterion: Explanation of Task Analysis	Added requirement
Efficiency/Cost of Using the System		
Use of the system will be more efficient and cost effective than conducting the same task without it.		Requirement eliminated by expert panel. The panel agreed that ROI was outside of the scope of this selection process.

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