

Learning Object Development and Repository Design for Digital Government Instruction

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Abstract

As the field of e-government expands and grows, the number of academic courses, professional workshops, online courses, and continuing education opportunities in this field also increases. Due to the interdisciplinary nature of the field, learning and teaching content tends to be pulled from numerous paper and electronic sources. This pilot study explored the potential structure and benefits of an online repository of electronic learning objects for the field of e-government. Design research was used as a methodology to design, implement, and evaluate an online learning object repository within the context of a University e-government course. The pilot project is described, qualitative evaluation findings reported, and implications and future research directions are presented.

1. Introduction

Over the last several years, there has been a burgeoning of research in digital government supported in large part by investments from the US National Science Foundation Digital Government Program. By 2004 approximately 70 projects, 20 workshops, 40 small grants for exploratory research and 20 planning grants had received approximately \$42 million out of this program. As has been noted by Gronlund and Horan [1] and others (e.g., West) [2], this rise of interest has created a challenge in synthesizing and articulating the range of e-government concepts, methods and applications.

The challenges of synthesis are further exacerbated by the nature of digital government research itself. A review of these grants outlines the evolution of the domain; the early projects tended to be more computer science and IT

oriented, while the later projects reflect additional perspectives from the social sciences. As digital government research has evolved, its fully interdisciplinary nature has become evident [3] [4]. Digital government research as defined by Dawes, Helbig, and Gil-Garcia [5] “applies computer, information, and social science methods in the investigation of the information-related needs, management and policies of government or the information-related characteristics of a democratic society.” This definition captures the interdisciplinary nature of the domain and the framework by Cushing and Pardo [3] highlights the challenges outlined by Gronlund and Horan [1]. Taken together, these researchers illustrate the characterization of digital government as being in the “embryonic stage” with researchers from many involved disciplines seeking definitions and frameworks to consistently and effectively guide their efforts.

The digital government community has consistently employed a variety of means to respond to these challenges. The most recent and perhaps most important effort is the formation of the Digital Government Society of North America (see www.dgsociety.org). The formation of the society represents a logical step in the evolution of this community and provides a venue for creating the necessary synthesis. Other efforts such as the use of the Society’s online discussions, an annual conference and the exploration of the feasibility of a professional journal [4] also contribute to these efforts.

An important opportunity exists to engage the digital government community in a synthesis and articulation effort; specifically, leveraging the expertise and experience of the community to

craft the definitions and frameworks, and to test the readiness of the community to create and use new resources. The purpose of this paper and study is to address one facet of the synthesis and articulation effort; the design and evaluation of learning objects and an online repository for ease of access and dissemination of e-government educational material.

2.1 Learning Objects

Learning objects are defined here as digital files or components that can be used, re-used or referenced within multiple learning contexts [14]. Wiley [14] provides additional insight into the definition and description of a learning object. While an informational website might meet the general requirements for learning object status, it is not granular enough for efficient use within a learning system. A learning object should provide a concise learning opportunity. In this way its inclusion within a course does not distract the learner from the targeted learning goal. The authors of this paper also posit that additional important aspects of learning object development include 1) the important role that metadata plays toward the goal of creating shareable objects for learning, and 2) the proper use of instructional design techniques in achieving this objective.

Returning to Wiley's definition of learning objects we find that one of the key concepts is "reusability". In order for a learning object to be truly reusable it must have the ability to fit into the context of another learning objective or lesson. Therefore, the development of learning objects requires a structured lesson plan in order to insure that the object is complete and able to convey a learning objective within itself.

Equally important to the development of learning objects is provision of libraries or repositories for proper storage and retrieval. Repositories or learning systems within the context of this paper refer to any digital system accessible to learners that are used to house a piece of instruction. Therefore, repositories provide the environment for learning object use. Learning systems range from linked web pages to automated learning management systems. Each of these systems requires certain levels of specification for use of learning objects within them. Valuable research both technical [12], pedagogical [13] and theoretical [14] has been

conducted regarding learning object development and dissemination. Inherent within much of this research is description of the need for metadata standards and frameworks that can assist in the overall utility of learning objects.

1.3 Learning Objects for E-Government

Demand for e-government learning resources comes from many quarters both in the U.S. and internationally, and is increasing through both more general recognition of the field and formal requirements. For example, information technology was recently added to the list of core competencies identified for students by the US National Association of Schools of Public Affairs and Administration (NASPAA), the accrediting body for these schools. Several universities now offer graduate-level digital government courses, and specialized degree programs are beginning to emerge (particularly in Europe). At the undergraduate level, Science, Technology and Society (STS) as well as disciplinary domains (e.g., political science, sociology) are important opportunities to introduce digital government concepts and research. Moreover, given recent attention to developing cyber-infrastructure for sciences, it is only appropriate that the field of digital government consider developing a cyber-infrastructure for training in e-government, one element of which would be a repository of e-government material (e.g. learning objects) for use in the classroom.

Naturally, along with the emergence of digital government as a research domain, many institutions are creating new courses, and in some cases even full programs focused on digital government. However, as of yet no workgroup or committee has emerged to assist in creating an infrastructure to support the development and sharing of these learning objects. Through use of a taxonomy specific to e-government and educational technology standards such as the Learning Object Metadata standard [6], e-government learning objects can be developed for standardized, efficient use and reuse across disparate learning contexts and systems.

Such an effort promises to complement activities of the emerging Digital Government Societies and the International Digital Government Community Building activities

underway. For example, the lack of a coherent set of resources to support a digital government curriculum has been a focus of discussion for the international digital government working group throughout the past several years.

2. Purpose and Objectives

The motivation for this study is to enable e-government curriculum to be developed in a manner that would be standardized, sharable, and universally accessible. The goal is for e-government curriculum developers to have the necessary resources to create sharable learning objects and robust e-government curricula that can easily and effectively be disseminated to learners within the field of e-government. The premise is that the easier we make it for people to find elements, options and support for instruction, the better we are able to provide for all types and levels of education [7]. Furthermore, the greater the repository of reusable and integrative e-government learning objects, the greater the value we bring to the citizen and learner.

The objectives of the pilot study reported herein were to: 1) develop a framework for e-government learning object development 2) design a prototype of an e-government course supported by a learning object repository. 3) obtain user feedback on the utility and value of the repository and learning objects within.

To achieve this objective this study utilizes a design research approach toward the development and testing of two key components; a model for e-government learning object development and an instantiation of an e-government course supported by a learning object repository.

3. Research Design

Design theory provides a useful approach to organizing the process of learning object and repository development and testing. The importance of design theory was first brought to light by Herbert Simon's [8] famous "Sciences of the Artificial". Since then, a whole body of research whose goal is to design and invent methods, processes and systems has emerged. The creation of IT artifacts and their evaluation is central to this paradigm. Design theory was

used in this research project to guide the development of content for a learning-object based e-government curriculum and to explore learning system and repository needs for managing and developing learning objects.

In keeping with recommendations by Hevner, March, Park and Ram [9] and others (Walls et al.) [10], this project includes three interrelated elements of design research. The approach involves an iterative sequence of user requirements analysis (explored through learning object development), prototype development (through design of a model for e-government learning objects) and evaluation (via student responses to course involvement).

4. Methodology

Discussion of the methodology follows design science research guidelines as proposed by Hevner, et.al [9]. It was their supposition that effective design science research should follow a common set of guidelines. Examples of these guidelines include producing an artifact, defining a problem space, evaluation of design artifacts and proper communication of research. These guidelines were used within this research to assist in design and evaluation of project artifacts.

4.1 Design as an artifact

This research occurred as a pilot project conducted throughout the duration of an e-government course from January through May 2007 within the School of Information Systems and Technology, at Claremont Graduate University. The course was planned so that e-government course content was explored through student development of learning objects that investigated specific facets of the e-government curriculum. Included in this investigation was creation of a learning object development model that could be used to guide proper inclusion of metadata and placement within a learning repository. Consequently, a prototype e-government learning object repository was created to house learning objects and provide a vehicle for dissemination and use.

The repository and learning objects were pilot tested by students in the course and constituted the repository "users" for evaluation needs. The

users each developed one learning object and provided “peer review” of each of the other learning objects created by other students. Each student provided input into the development of an e-government course, designed a learning object for a specific topic within e-government, and implemented the learning object according to a class-based taxonomy within a learning management system adapted for this specific context. Finally, user feedback was obtained from learning object developers on the perceived utility and value of the learning objects and repository.

4.1.1 Learning object development model

The first artifact created was a learning object development model to be used for e-government content creation. Students were asked to demonstrate knowledge of a socio-technical approach to e-government by creating a learning object using theories, concepts, applications and discussion from class. The model students were asked to follow was based on facets of instructional design theory [11] [12]. The general requirement for learning object identification is in providing a description (e.g. metadata) of its educational context. Reusability is contingent upon an object’s ability to fit into the context of another learning objective or lesson. Therefore, the development of learning objects requires a structured development plan in order to insure that the object is complete and able to convey a learning objective within itself [12].

One of the first course tasks asked students to develop the outline for an e-government learning object. First, students were to provide an introduction to the lesson and background to the information to be learned. In terms of metadata this would describe the object and relate prerequisites and associated learning opportunities. Next students were asked to relate an outline of the learning, which included its context within an e-government taxonomy (to be discussed later), learning objectives and course tasks. These metadata elements would describe where within a course or lesson the learning object should reside and requirements for use of the object (E.g. Does it involve multimedia? How long will it take?). Finally, they were asked to develop a summary of the object which included review of what was learned, preview of logical next steps in learning about the subject

and references to further subject resources. This would provide metadata that assisted in describing proper sequencing of learning objects and reference to further learning objects that could be used to support different learning styles or needs. The overall assignment was used to guide creation of the student’s learning object.

4.1.2 Instantiation of an E-Government Course developed with Learning Objects

Standards such as the Learning Object Metadata (LOM) standard [6] are being developed so that learning systems are able to find, share, and reuse learning content in a systematic manner. LOM specifications work in accordance with multiple standards bodies (e.g. Shareable Content Object Reference Model (SCORM) and/or the Aviation Industry CBT Committee (AICC)). Development of learning objects requires utilization of such standards to ensure the effectiveness and extensibility of educational development projects.

Although it was beyond the scope of the course to develop a comprehensive e-government learning object repository, it was deemed necessary to develop an artifact that provided an immediate system for storing learning objects developed in the course and for evaluating an instantiation of an e-government lesson supported by learning objects. This prototype can be found at www.horanlearning.org and content within can be accessed using a guest account. The prototype utilized the Moodle course management system version 1.7. Moodle is an open-sourced course management system built using the PHP programming language and backed by a MySQL database. This system was utilized for two main reasons: 1) the pedagogical principles used in development of the software and 2) its conformance with learning and content sharing standards including SCORM and AICC.

The instantiated artifact consisted of a course titled, “Applications of Socio-technical Theory in E-Government”. This course was identified and developed through class readings and discussions and it was determined by students that development of learning objects within this domain would be beneficial to future e-government students and instructors. Within this course five interrelated learning objects were developed.

Learning object titles included:

- Impact of Socio-Technology in Management of E-Government
- Planning and Evaluation Dimensions in E-Government
- Socio-technical Case Studies
- E-Activism and its impact on E-Government
- Taxonomy for E-Governmental Systems beyond the Socio-technical Approach

Each learning object consisted of 8-12 pieces of content that might include text, images, video [See Figure 1] and an evaluation component that can be tracked by an instructor and/or that can be used to dictate course progression. The course is laid out with an introduction at the top of the page followed by several sections identified as topics. Each topic consists of learning objects that make up the lesson content. Importantly, each of these learning objects or lessons can be exported in a standardized learning system format (e.g. SCORM) that can be imported by an altogether different learning management system.



Figure 1: This learning object discussed the impact of web-based mediums such as YouTube and Blogger on politics.

4.2 Taxonomic Development

It is commonly understood that a syllabus provides a roadmap for course progression. Possibly less understood is that a taxonomy does the same in providing a roadmap for learning object development, dissemination and access. In

keeping with the syllabus analogy, the taxonomy and underlying metadata are used by the instructor in pulling together curriculum and by the learner in understanding the course path. Taxonomy within a specific domain such as e-government provides this same path. Richey [15] recognizes that the creation of conceptual models such as taxonomies assists in identifying, organizing and defining the relationships between similar variables.

The role of properly describing metadata within a learning object has important implications in regards to interoperability and ultimately proper identification of that object. Yet when trying to pull together instructional content, if instructors and subject matter experts are not provided with ontologies and taxonomies to assist them, the process can be an extensive burden. It is vital that instructors (and students) be able to easily find and import content into authoring and learning systems [16]. Wiley [14] maintains that, “Taxonomy development requires significant effort above and beyond normal instructional design and development, and is certainly one cause of the current poverty of instructionally-grounded practical applications of learning objects” (p.28).

Within several class sessions brainstorming about proper taxonomy development was discussed [Figure 2]. One student in particular took on this task and developed a learning object relating this need.

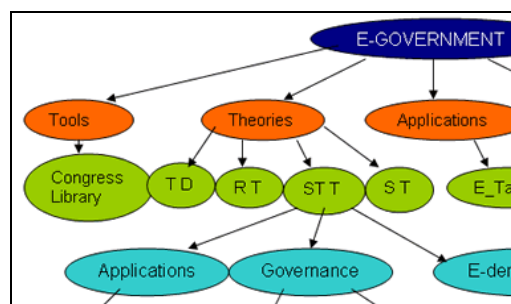


Figure 2: Taxonomy brainstorm

Although the focus of this design research was not on the specifics of e-government taxonomic development, it was determined pertinent to include this facet as part of the dialogue in order to begin rigorously evaluating development needs and to begin a much needed dialogue. Outside of standards and use of

authoring systems it is possible that one of the most important aspects of learning object development to be encouraged is awareness of the role that taxonomies and metadata plays toward the goal of creating shareable objects.

4.3 Design Evaluation

Learning object developers that participated in the pilot project were asked to provide an assessment of the process at its completion. They were asked to assess the utility and value of the learning object repository, learning objects, taxonomy, and structured development process. A set of five qualitative, open-ended questions were administered by a third party through an online questionnaire (SurveyMonkey.com). All e-government class members were asked to respond anonymously, were not asked to provide personally identifiable information within the survey, and they were insured that comments in no way would have an effect on grades within the course. All class members responded with completed answers.

The pilot project participants were asked questions along the lines of 1) challenges to gathering essential e-government content during the process of creating a learning object; 2) how learning object development impacted the domain knowledge of the learning object developer; 3) the perceived value of a learning object repository for e-government learning; 4) the perceived value of a taxonomy for guiding learning object development; and 5) the overall perceived value of the learning objects created by participants. Questions and related discussion are provided below.

5. Results and Discussion from User Feedback

5.1 E-Government Content

Participants in the pilot study were asked about the level and types of difficulties they experienced assimilating e-government content while engaged in the process of developing their learning objects. Responses focused on three areas described below.

First, participants discussed challenges with finding definitions and explanations about the

theoretical underpinnings that the field of e-government is built upon. E-government is multi-disciplinary and the basic foundational theories could thus reside in a wide range of academic outlets. Respondents discussed how finding appropriate literature on the theories was difficult, pointing to the potential benefit of having such theories in an accessible repository. One participant wrote:

The first issue was getting a good definition and resource materials for Socio-Technical theory. If the object is built on socio-technical theory then we need to know what that is.

Similarly, another respondent wrote:

Since this is a new specific field...most of the [e-government] resources did not have a solid theory to support them [that I could find].

On the contrary, the challenges with gathering information about common e-government content and subject matter were more associated with assimilating a large amount of available information into a condensed and understandable form. The web is rich in content. So rich that content selection and organization become the primary challenges. One participant wrote:

The Learning Object, E-Activism, seemed to have ample resources to choose from. The real difficulty was trying to synthesize the material to a concise, coherent package of information.

Another responded:

I did not find any difficulties at all when dealing with information gathering for my object...there was an abundance of material.

Participant responses pointed to how this issue illustrates the growth of the topic and field of e-government and the opportunity to provide a platform for assimilating and sharing learning object content.

A third challenge faced by learning object developers was in understanding the concept of a learning object in and of itself. One participant wrote:

...the "learning object" concept was initially unclear to me. In the process of completing this

project, I have acquired a concrete understanding of the uses, purposes and definition of learning objects.

The last set of responses illustrated the need to ensure that a large audience of e-government educators, researchers, and practitioners understand the value and concept of learning objects if widespread participation is to be expected. Providing simple and visual explanations of the learning object concept and process should be an important priority to ensure use of the repository should it be implemented for the wider community.

5.2 Impact of Learning Object Development on the Developer

A second line of questioning asked of participants was 1) the participant's level of knowledge about e-government (limited, basic, intermediate, advanced, expert) at the beginning of the pilot project and 2) how that knowledge changed through the learning object development process.

The purpose of this question was to assess how the learning object development process impacted user's knowledge about e-government. All respondents wrote that their prior knowledge of e-government was at least at an intermediate level and that their knowledge specific to the learning object content areas developed during the course of the pilot study had increased significantly. Participants wrote:

The learning object development process has...considerably increased my knowledge of the actual framework of e-government as well as related concepts...

Another expressed:

I would rate my knowledge as intermediate in the overall subject of e-Government. However, when specifically dealing with the learning object of focus (Socio-technical Approach) I would rate myself far into the advanced field.

Several others expressed similar thoughts explaining how the structured process of learning object creation had indeed enhanced understanding about the domain of e-

government, putting it into an organized framework. One wrote:

The learning object experience provided a unique way of focusing attention to the specific topic of focus and forced a certain writing style that caused learning to be more pronounced. The learning object experience provided a methodology that forced more attention to the specific areas and their interrelationships.

While the answers received here may seem expected and similar findings are well-documented in the education literature, they verify that the learning object creation process did not detract from e-government learning. It is also important to note that due to the positive experiences described by participants, there may be significant learning potential for the larger e-government community to not only use learning objects for training and education, but also to participate in creating new learning objects.

5.3 Perceived Value of a Learning Object Repository

The third question asked of participants related to the value of the e-government repository that houses learning objects. Participants were asked whether they would use such a repository in the future and why or why not.

This question was posed to student participants to try and understand the value that a learning object would have on future education in the e-government domain as well as touch on the user requirements of a learning object repository. Respondents all believed a repository would be very beneficial to future learning. One wrote:

I intend to focus my future education on e-government...and, without any doubt, learning objects would be valuable.

Several respondents described important requirements for an e-government repository. Several explained a need to continuously update the repository to ensure that learning objects would stay up-to-date and that collaborative (or other) efforts would be essential to meet that challenge. One wrote:

Learning objects do serve as a valuable resource but like any text it will be dependent on the level of material created by the author. Over time, if they are not based on groupware or collaboration efforts they will get out of date and a 'Google' search might provide more current information.

Likewise, another wrote:

If the Learning Object continued to be refined and developed, then I believe there would be value added and would be useful.

Others related that a repository could provide a valuable replacement to paper text as well as complement in-class instruction. They wrote:

If [e-government] began to grow into full courses I would MUCH prefer this [learning object] approach to a standard book.

And: It [Learning Object] could form one facet of learning, augmenting a classroom experience where an expert instructor could facilitate in depth discussions that typically arise in a classroom environment.

Taken together, respondents believed there was value in a learning object repository as a learning tool for e-government classes and that the repository would need to include participation at a level that would ensure updated and ongoing content development. A feature within the web based repository that could facilitate this characteristic would be an important future consideration.

5.4 E-Government Taxonomy for Learning Objects

The fourth question posed to participants related to the development of an e-government taxonomy and how the development of that taxonomy contributed (or deterred) from creating an e-government learning object.

The purpose of this question was to help evaluate the value of the e-government taxonomy as a mechanism for organizing the repository. Participants agreed that the taxonomy played a vital role for organizing

learning objects within the repository. Several wrote statements similar to the following:

...proposing and explaining an E-government taxonomy is fundamental for providing a framework to organize e-government learning objects.

Participants had differing perceptions about the role the taxonomy played in the development of learning objects. Some described the taxonomy as playing an active role explaining:

It forced us to think about the topics that were being discussed and helped to provide a way to relate the different ideas and concepts.

Similarly, another wrote:

It helped me understand how Eglos [e-government learning objects] relate and therefore obtain a more accurate perception of them.

Others felt that the taxonomy played more of a back office, behind-the-scenes role explaining:

I had a general idea of where our... objects sat in the grand scheme of things. Once I had this I did not focus too much on the taxonomy.

In sum, participants described the role of the taxonomy as important for the organization and placement of learning objects within the repository, but felt that knowing the taxonomy became more intuitive through using the repository.

5.5 Educational Value of Learning Objects

Participants were asked to describe their broader perspective on the educational value of learning objects for both students and professionals. Answers included the benefits of "hands-on" learning, the use of multi-media as an important learning tool, and the benefits of a distributed platform to access learning opportunities any place, any time. One stated:

I think this type of learning for myself was great. I learn best using resources like this. I would be

very interested in taking courses later in life through learning objects.

Several explained that the value came from having a method to both create objects and pull objects from a repository to allow for immediate access to focused content. One wrote:

It became a good method to force additional focused analysis of ideas and concepts and their interrelation.

Some participants responded in direct relation to the value learning objects bring to the field of e-government. One wrote:

Our module was created by knowledgeable students and employees who have experience working on either e-government or related issues. This enabled me to gain a comprehensive, real-world, understanding of e-government.

The overall value of the learning objects repository and the learning objects themselves were believed by participants to be very high and potentially far reaching. While the questions and answers described above were somewhat broad in nature, the overall objective of the user evaluation was to understand user perceptions about the process of creating learning objects, using the repository, and value of such tools for e-government education. Answers were supportive of the concepts, ideas, and model used yet also provided insight into the needs and requirements for a more robust system.

6. Research Contribution

The pilot study reported in this paper provides a proof of concept and initial foundation for the e-government community to build upon. While the study reported herein included a relatively small group of users, a next phase of research should be larger and more inclusive across the e-government domain to include researchers and practitioners from a range of academic and government organizations. Such a study would provide valuable input into the design and development of an innovative, comprehensive, and valuable repository for e-government education. The next phase of research should include:

- Further assessing the need for and interest

in a digital government taxonomy and repository for learning objects.

- The expansion of the digital government learning objects taxonomy by engaging a wide range of stakeholders.
- The refinement and expansion of the digital government learning objects repository that contains objects classified according to the expanded and refined taxonomy.
- Establishment of a management and governance structure for these new resources within the newly formed Digital Government Society of North America.
- Development and implementation of a communications plan designed to increase the application of the taxonomy and the use of the repository.

The Digital Government Society of North America (DGSNA) has expressed interest in supporting this effort and has agreed to work with the project team to facilitate input from throughout the digital government community. Findings from this examination will contribute to understanding about the emergence of new domains and the timing of investments in the creation of resources such as taxonomies and repositories as tools to share knowledge about these new domains.

The product developed through this study will allow for learning opportunities within the field of e-government to occur in a broad range of educational settings that is not limited to large research institutions and universities, but the full array of domestic and international learning environments that are looking for educational e-government content. While major universities have the resources and capacity to put resources and faculty online (e.g., MIT OpenCourseWare), there are a significant number that are unable to generate these opportunities. This project represents a targeted effort to generate the ability for a broad group of e-government focused educational institutions, large and small, to use eGLO.

7. Conclusion

There is a stream of activity in the development of online educational content (e.g., learning objects). There is a parallel stream that has identified a need for e-government educational resources. This project brings these streams together in a manner that is focused on the needs of users, instructors and developers culminating in a hybrid approach used to link learning methods with emerging content needs and ultimately can substantially impact the way e-government education is designed, taught, and learned. The project product will add to knowledge about taxonomy development in emerging fields as well as learning objects, design science, and curriculum development. The models and methods used in this research have potential value as they come together to form new interdisciplinary research, practice and instructional perspectives. In many ways the project embodies the advice of Andries Van Dam; in his HICSS 2003 keynote "Beyond Today's Web-based Educational Content" [17], called for a learning objects approach to education. This project aims to respond to this call, within the context of digital government.

8. References

[1] Gronlund, A., and Horan, T., E-Government Concepts and Developments, Communications of the AIS, Vol. 15, Article 39, 2005.

[2] West, D.M. Digital Government: Technology and Public Sector Performance. Princeton University Press, 2005: Princeton, NJ.

[3] Cushing, J., & Pardo, T.A., Research in the Digital Government Realm. IEEE Computer, Special Issue on Digital Government, 2005.

[4] Dawes, S. S., Gregg, V., & Agouris, P. Digital government research: Investigations at the crossroads of social and information science. Social Science Computer Review, 22, 1, 5-10., 2004. <http://ssc.sagepub.com/cgi/content/refs/22/1/5>

[5] Dawes, S.S., Helbig, N., & Gil-García, J.R. Exploring the feasibility of a digital government journal (Project Highlight). dg.o 2004 Proceedings. Washington DC: National Science Foundation, 2004. <http://dgrc.org/dgo2004/disc/presentations/community/dawes.pdf>

[6] IEEE Standard for Learning Object Metadata. (2002). IEEE Std 1484.12.1-2002, i-32.

[7] Moore, M.G. On a theory of independent study. In D. Sewart, D. Keegan, & B. Holmberg (Eds.), Distance Education: International Perspectives. London: Croom Helm, 1983.

[8] H.A. Simon, *The Sciences of the Artificial*, MIT Press, Cambridge, MA. 1969.

[9] Hevner, A. R., S. T. March, J. Park, and S. Ram. Design Science in Information Systems Research. MIS Quarterly, 2004. 28(1): p. 75-105.

[10] Walls, J.G., G.R. Widmeyer, and O.A. El Sawy, Building an Information System Design Theory for Vigilant EIS. Information Systems Research, 1992. 3(1): p. 36-59.

[11] Moore, M.G. On a theory of independent study. In D. Sewart, D. Keegan, & B. Holmberg (Eds.), Distance Education: International Perspectives. London: Croom Helm, 1983.

[12] Merrill, M.D. Component Display Theory. In Reigeluth, C.M., ed. Instructional design theories and models. Hillsdale, NJ: Lawrence Erlbaum, 1983.

[13] Baker, J., Botts, N., Owen, K. Faculty Technology Training: Learning About Learning Objects. Academic Exchange Quarterly. Spring 2004.

[14] Wiley, D. A. Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In D. A. Wiley (Ed.), The Instructional Use of Learning Objects: Online Version, 2000. Retrieved April 10, 2003: <http://reusability.org/read/chapters/wiley.doc>

[15] Richey, R. C. The Theoretical and Conceptual Bases of Instructional Design. London/New York: Kogan Page Ltd./Nichols Publishing Co., 1986.

[16] McClelland, M. Metadata standards for educational resources. Computer, 36(11), 107-109., 2003.

[17] van Dam, A, Plenary Speaker, "Beyond Today's Web-based Educational Content", HICSS-36 2003 (January) .