

ACADEMIC COMPUTING INFRASTRUCTURE PROGRAM EVALUATION

by

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A DISSERTATION

Presented to the Department of Educational Methodology,
Policy, and Leadership
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Education

September 2014

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DISSERTATION ABSTRACT

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Doctor of Education

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Academic computing is one major component of Information Technology infrastructure affecting the availability and utilization of technologies at universities. The study here evaluated two different colleges at the University of Oregon in comparison to a minimal logic model proposed here, the Support for Academic Computing Model (SAC). Based on the differences in IT needs and implementation of existing instructional technology services, the evaluation investigated the utility of the logic model and information regarding the two settings. The two colleges are the College of Education (COE) and the School of Architecture and Allied Arts (AAA). My hypothesis is that empirical evaluation studies based on a comparison with a base logic model for infrastructure needs across contexts may help to provide information to better align resources.

Results show that a strong use case of 100% of faculty interviewed at COE rely on Learning Management Systems (LMSs), Data Visualization and Video & Audio tools, making them a core part of the SAC model. Most faculty interviewed in AAA utilize LMSs at 89%, then Productivity/Content Creation/Research Tools at 83%, and as an extension Instructional Media Tools at 46%, which helps to validate the SAC model

across this second context. Other information in the model evaluation allows more specific comparisons of gaps in areas such as access to resources, knowledge of and about resources, mission-driven need for resources, and some patterns.

Common themes that emerged from the faculty interviews are the need to showcase technology usage among colleagues, that services are not always well advertised, that technology may not be accessible or that there may be issues regarding limited or unclear funding for both support and resources that limits their use. This indicates that this style of a model might be helpful in planning and evaluating academic computing support programs and services. Future work would be needed to investigate the degree to which intervening according to the findings of such a model might be efficacious to improve the perceived quality of services or the usage patterns and outcomes, as well as the degree to which such a model could be generalized and evolve over time.

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Scalise, K., Cheng, N. Y., & Oskui, N. (2009). Rasch family models in e-learning: analyzing architectural sketching with a digital pen. *Journal of Applied Measurement*, 10(3), 281-295.

ACKNOWLEDGMENTS

I wish to express sincere appreciation to my advisor and chair Dr. Kathleen Scalise for her guidance, assistance and care toward my doctorate endeavor. I would additionally like to thank my other committee members Dr. Joanna Goode, Dr. Yong Zhao and Dr. Andrzej Proskurowski who were very supportive and resourceful, providing invaluable input. Also I would like to extend my gratitude to the IT staff I consulted with and faculty I interviewed who were part of the sample who contributed toward my empirical findings. I would like to offer extreme gratefulness to Dr. Kassia Dellabough and Dr. Dena James for their enduring support and encouragement during my doctoral program, especially towards the end when I needed them the most. Moreover I could not have pursued this degree without the support from my supervisors, JQ Johnson (rest in peace), Andrew Bonamici and Helen Chu. Last but not least I would like to express my profound gratitude toward my family, spouse, friends and colleagues for believing in me.

This work is dedicated to my dear mother who wanted me to achieve what she didn't have the opportunity to attain. She always put my academics first and didn't want anything to divert my potential.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Academic computing is one major component of Information Technology (IT) infrastructure affecting the availability and utilization of technologies at universities. The study here evaluates two different colleges at the University of Oregon in comparison to an academic computing logic model proposed here. Based on the differences in perceived IT needs and implementation of existing instructional technology services, the evaluation investigated the utility of the logic model and provides information regarding the two settings. The two colleges are the College of Education (COE) and the School of Architecture and Allied Arts (AAA).

Academic computing, or technology used for instructional and scholarship purposes, is crucially important to the overall educational goals and success of post-secondary education in today's university settings. As researchers describe, "computing is a vitally important tool in the academic environment. University and library computing resources receive constant and growing use for research, communication, and synthesizing information" (Vaughan, 2004, p. 159).

Given the importance of instructional technology at post-secondary institutions, or in other words universities and colleges, the purpose of this study is to focus on the academic computing component out of the full scheme of university-level IT infrastructure. An academic computing logic model is introduced that presents elements of computing tools often considered essential in the academic arena. My intention is to

describe a baseline of what is necessary for campus computing operations to work cohesively to support the academic agenda.

The following research questions are addressed:

- RQ1. How comparable is the educational technology infrastructure of the University of Oregon College of Education (COE) to the proposed academic computing model?
- RQ2. How comparable is the educational technology infrastructure of the University of Oregon School of Architecture and Allied Arts (AAA) to the same academic computing model?
- RQ3. Utilization:
- a. What proportion of the available educational technology infrastructures in (1) and (2) above are utilized by faculty in COE and AAA?
 - b. Using the logic model framework, is it possible to describe problems and gaps involved in the utilization of educational technology services for these two organizations?

Figure 1 is a diagram of four major elements that influence IT Infrastructure from an organizational theory perspective that was created by the author as part of this research. The elements that contribute to this model are derived from a literature survey. In the following sections components are listed and described thoroughly describing why they are critical parts of academic computer via associated scholarly material. The diagram describes the support needed for academic computing in a given context, the existing operational capacity to support these needs, and the decisions and leadership by policy-makers to bring these into appropriate alignment. Leadership and policy choices

such as these can be informed by evaluation studies such as proposed here. My hypothesis is that empirical evaluation studies based on a comparison with a minimal base logic model for infrastructure needs across contexts may help to provide information to better align resources.

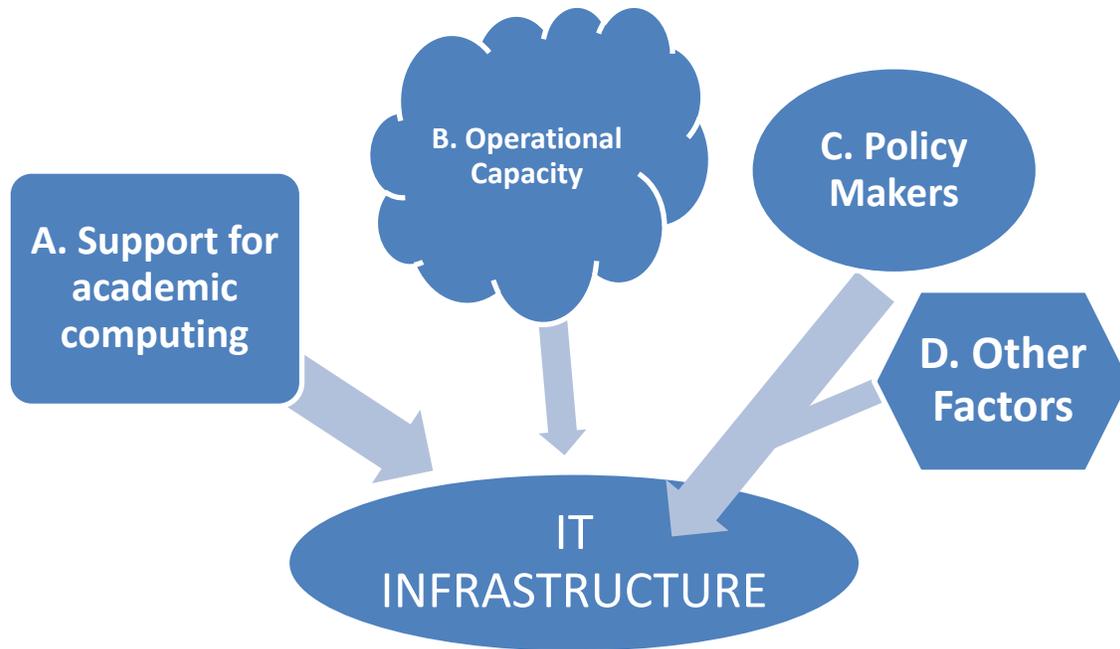


Figure 1. Diagram of IT Infrastructure with 4 contributing components (A, B, C & D)

Key Definitions

Academic computing is defined here as teaching and learning with educational technology. It incorporates the use of computer technology by academics (faculty and students) for conducting scholarly work involving instruction and research. According to one group of researchers, “Academic computing is roughly 40 years old; it has operated in a rapidly changing environment and has strong connections to the commercial worlds of computer hardware and telecommunications” (Herro, 1999, p. 10). Academic Computing can have a different meaning in some specific disciplines such as Computer

Science. In Computer Science, Academic Computing refers to computing practices in an academic setting. It has more of an applied nature for various programming elements. For campus support efforts, however, the technology infrastructure in place to directly support teaching and research often comes under the umbrella term of “academic computing” as compared to “administrative computing” that often refers to information technology needs for administration of the institution more broadly, such as personnel and human resource systems, budget tracking and financial systems, and overarching infrastructure needs such as the network and connectivity. While necessarily these two areas have some overlap, universities often employ the distinction to organize technology resources.

The (WASC) Western Association of Schools & Colleges (2000) defines educational technology as a systematic way of designing, carrying out and evaluating the total process of teaching and learning (p.2). WASC describes how technology is used in teaching and learning for delivering education, learning about computers, establishing distance education, providing access to learning resources, supporting curricular use, facilitating student learning outside of the classroom, and enhancing the quality of learning and the administration of courses. Albright & Nworie (2007) similarly suggest that academic technology issues and requirements be incorporated into the university's overall technology plan in order to actively promote the use of technology in support of the educational and research mission of the university. Having technology as part of the university mission necessitates “building partnerships with the faculty senate, library, information technology, faculty development center, distance/continuing education center, and other campus areas as appropriate to work collaboratively toward

achievement of university strategic goals that can be addressed by instructional technology” (Albright & Nworie, 2007, p. 65).

Instructional technology, or IT, is a related term to academic computing. Often broader as it may include a wider range of technology, it is also narrower in that the focus often is restricted more directly to the classroom and virtual instructional mission rather than also incorporating the full range of research and scholarship that may be in place in a post-secondary context. IT is defined by the Information Technology Association of America (ITAA, 2007), as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware” (p. 30).

Figure 2 displays a representative array of components necessary for campus computing infrastructure as described in the literature. It describes a concept of operational capacity in terms of academic technology infrastructure and facilities, fiscal arrangements, accountability mechanisms and infrastructure management/support for administrative computing.

IT, ICT, and Educational Technology (ET) often are synonymous terms and used interchangeably. For the purposes of this study I will use the term educational technology. Within higher education institutions, Educational Technology includes tools that arrived with the 'Information Revolution' (Katz, 2002). The information and communication technology (ICT) infrastructure influences and shapes the nature of higher education institutions and the practices of faculty and administrators. IT includes all components of informational technology used in the delivery of educational material.

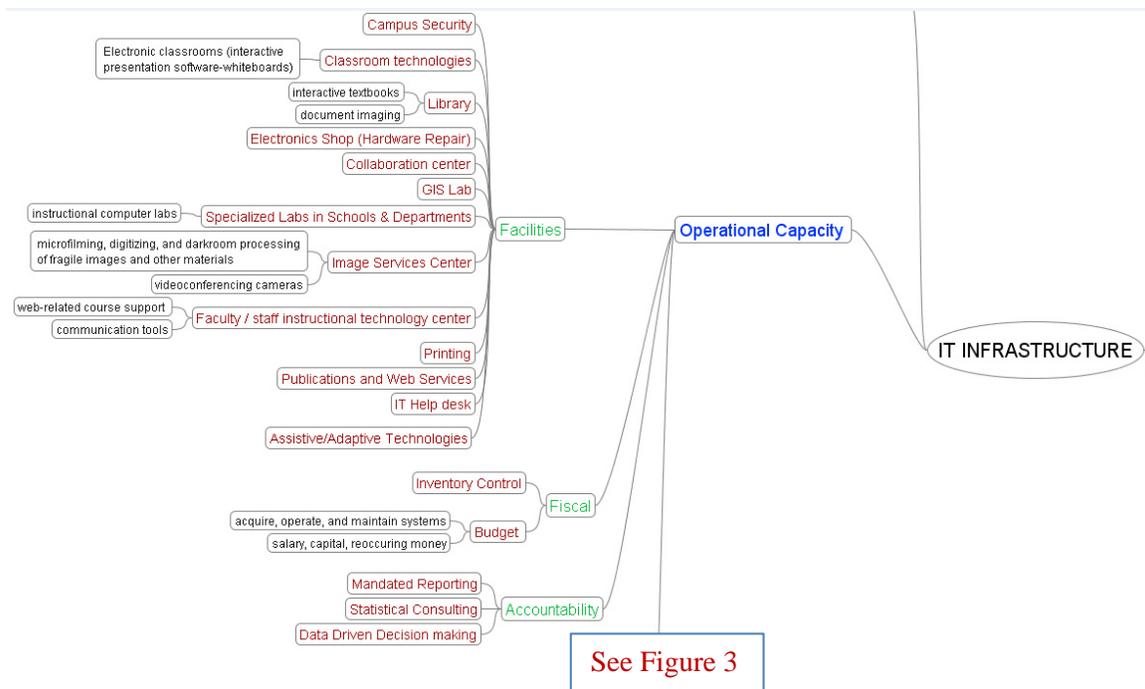


Figure 2. IT Operational Capacity branched off of IT infrastructure as component B1 of the diagram in Figure 1. In order for all IT to function, these operations need to be in place and fully functional. And the continuation of Operation Capacity is displayed in Figure 3.

IT is also known as E-learning, Instructional Technology, Learning Technology, Information and Communication Technology, Computer Aided Learning, and Computer Mediated Communication.

The influence of technology on campus has evolved new types of instructional practices. A specific example of how technology becomes a medium for improving some instructional design practices is Universal Design, or the process of improving accessibility online for all students. “Universal Design for Learning is a set of principles for curriculum development that give all individuals equal opportunities to learn” (CAST, 2013). While “successful implementation of Universal Design does not have to rely solely on technology, technology is a useful medium for creating maximum access to course content” (Izzo, et al, 2008, p.34). Educational technologies can enhance, enable

and extend teaching and learning environments. When used appropriately, educational technology may show some promise to extend the possibilities of learning environments. Providing more tools for teachers and students, as the Universal Design example shows, may be especially helpful for those with disparate learning needs. However to take advantage of the benefits of technology, every institution requires a solid infrastructure to maintain instructional support.

One major focus of educational technologies currently is to expand teaching and learning through the use of virtual materials, tools, and environments. By removing time and distance barriers, technology can make it possible to bring virtual content into the learning environment. As will be discussed in the literature survey, technology allows for new ways to enhance instruction and engage students, both of which may lead to better learning outcomes, although the downsides of technology use can be substantial as well.

Clearly establishing academic technology as part of the university mission “serves as a catalyst for curriculum improvement and change across the university by building and sustaining relationships with faculty, chairs, and deans around strategies and programming that facilitate innovation in curricula (Albright & Nworie, 2007, p. 65).

Due to their research focus, higher education institutions often are trend-setters when it comes to application development and use of tools. Such technologies “create new capabilities and new ways of organizing the higher education mission, information resources, and services” (Katz, R., 2002, p. 54). With such an encompassing mission and the wide availability of resources, institutions can accomplish more with technology services:

“Educational Technology is a complex, integrated process involving people, procedures, ideas, devices, and organization, for analyzing problems, devising,

implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning.” (Ehrlich, D., 2002).

However, there are many challenges, such as pedagogically enhancing the teaching experience to enable students to learn better or faster, securing time for research and professional development, coordinating and enhancing resource utilization, and providing students a customized or unique learning experience (WASC, 1999). Given the intricate involvement of teaching and learning processes with infrastructure and support needs, evaluating the availability and utilization of technology rises in importance.

The literature review

The next section of this research is a literature review that explores the history of academic computing, and provides information to inform a current logic model for evaluating some academic computing needs.

The early history of academic computing on campuses

Albright & Nworie (2008) describe how academic computing began to appear as an institutional effort on university campuses in the U.S. in the 1960s and 1970s. They state that media center directors in early efforts sometimes failed to recognize its significance and the characteristics that clearly defined academic computing as instructional technology. Therefore support for computer-based learning, and eventually online and virtual learning environments, often evolved in independent academic computing or IT organizations (pp.17-18). Also many examples of early academic computing were developed in continuing education units across the country – much like University of Oregon’s example.

A fragmentation of academic technology across support services often occurred in prior years. Technology developed and became more and more central to an institutions functionality, but the institution may or may not have had processes in place to consolidate efforts or otherwise bring about coherence in services. Such fragmentation continues in some contexts today. Some examples are the development of independent media centers, IT and academic computing organizations and unit-based centers, libraries, faculty development centers, and distance education/continuing education offices. This has resulted in a diffusion of leadership for academic technology creating major challenges to access and efficient resourcing (Albright & Nworie, 2008, pp.15-16).

Diaz (2010) describes the importance of more recent organizational structures that often integrated IT, faculty development, the library, and campus support services. Integration emphasized the shared responsibility for providing a variety of support elements to the faculty, staff and students, helping them function in a technological environment for reinforcing learning.

Developing academic computing as a support unit on campus fully embedded into the academic mission became a major outcome of this integration trend at many universities. Services provided training, professional development, networking services and ran the gamut of technologies available to the institution as a whole. Even the scholarship and research mission became closely associated with such units. For instance, “early research on distance learning emerged from the need to enhance academic

computing capabilities from mainframes systems to the more agile desktop systems for classrooms” (Webb, 2005, p.21).

Given the important role that technology came to assume, academic institutions rapidly faced challenges and opportunities due to the increasing reliance on technology (Wierschem & Ginther, 2002). Ehrlich (2002) and Katz (2002) both state that the rapid historical development in the field of educational technology has profoundly affected the educational process in higher education. According to this research, technology has permeated all levels and aspects of university operations. With regard to academic affairs, at some campuses even the hiring, tenure and promotion practices at some universities are currently undergoing a technology emphasis for faculty who employ it in instruction due to its rising role in some areas of instruction.

Academic Computing is critical due to the institutional goal

Technology has continued to be a growing part of the academic environment. Facilities developed to help provide support at universities have included the general computer labs for accessing learning resources, distance learning facilities, presentation classrooms, integrated labs and remote technology (WASC, 1999).

Current campus community and IT expectations. Kramer & Maughan (2001) characterize the ‘Modern Campus’ as a learning environment of flexibility, which embraces technological tools that enable it to connect teachers and learners in effective ways. A commitment to providing a sufficient IT infrastructure generates a range of technical and institutional administrative and academic support issues. For instance these may include data storage, maintenance (as shown in Figure 3), and technical troubleshooting, as well as institutional buy-in, openness for integration with other

systems, budget allocation, and administrative support as the plethora of factors involved. Even as facilities and support have expanded in many cases, campus communities have become increasingly demanding in their expectations of IT infrastructure (Kramer & Maughan, 2001).

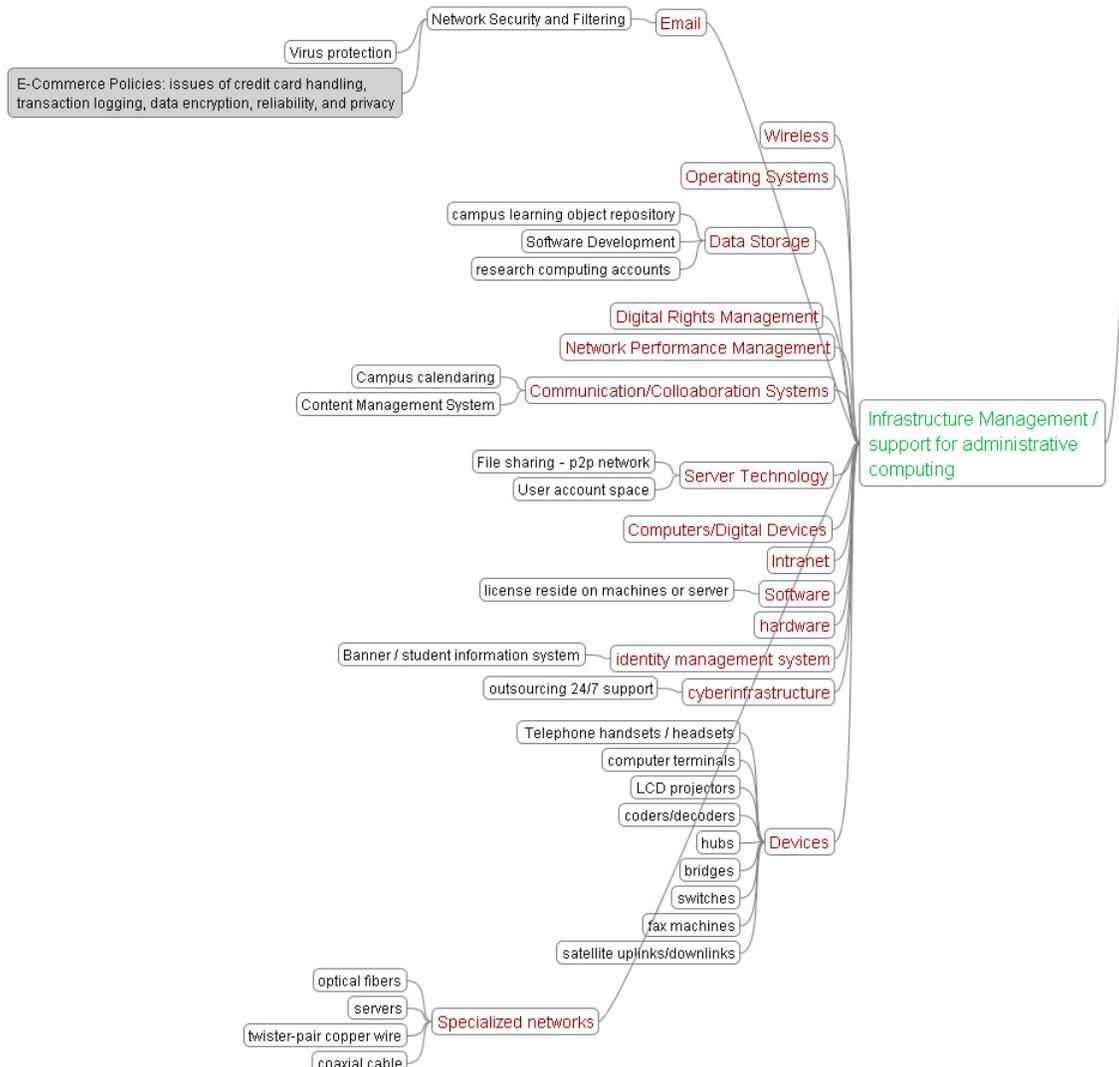


Figure 3. A continuation branching off of Operational Capacity as Administrative Computing for Enterprise Wide systems, as a part of component B2 of the diagram in Figure 1.

“New infrastructure will make new modes of teaching and learning possible and will change the economies of scale in higher education” (Kramer & Maughan, 2001, p.103).

Policy makers and IT governance help enable support services at the institution. According to Kramer & Maughan (2001), it is a challenge to integrate technology across campus; therefore, key stakeholders such as IT managers, administrators, faculty and students need to be given the opportunity to provide feedback for improving communication and information systems. Many institutions have faculty senates, planning committees and other forums where major technology decisions are put on the table for discussion.

Katz, R. (2002) suggests that leaders must articulate an institutional/organizational vision that grants widespread access to IT services. Kramer & Maughan (2001) echo a similar concern in which administrators, deans, directors, department chairs, and faculty are sometimes out of sync with their communication and information systems staff (p. 85). To represent the “Policy Maker” node C of Figure 1, Figure 4 displays the intricate network of some of the major policy makers who may be involved in making IT effectively available at university campuses as presented in the literature. Faculty meetings offer a platform to share IT support needs, but the increasing complexity of IT places new demands on policy planning strategies:

One of the most complex areas of impact associated with the emerging infrastructure is the policy arena. New technologies create new capabilities and new ways of organizing an institution's mission and information resources and services” (Kramer & Maughan, 2001, p. 98).

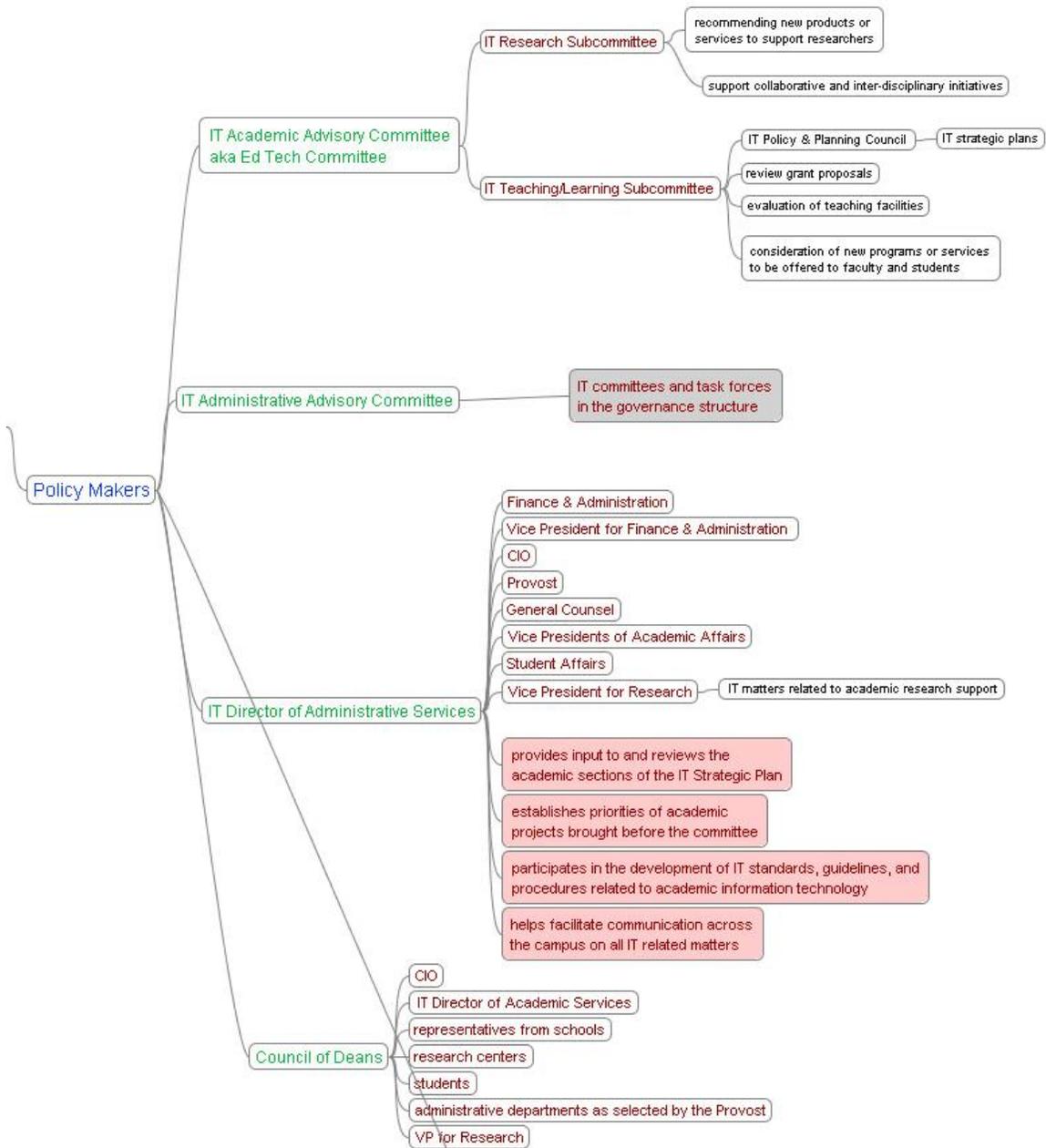


Figure 4. Policy Makers involved with IT Governance, as component C of the diagram in Figure 1.

The complexity of support for students, faculty and staff is an ongoing discussion that changes over time.

Components within Academic Computing

Kramer & Maughan (2001) among many professionals, state that a ‘Modern Campus’ has all of the components for IT Infrastructure in its entirety as a minimum basis for academic computing to function properly. Reasons for slow adoption and implementation include limited or problematic access to resources (e.g., appropriate hardware), high costs, and poor technical support in schools, as well as reluctance on the part of teachers to change tried-and-true instructional practices and take risks with new technology (Weston, 2004). This then leads to conclusions about how the layers of support, though they may have their unique challenges, must overlap and inform each other. Due to the complexity of implementation, having a base model, or minimal sufficient model, in place could assist institutions in covering many of the basic needs of academic computing. Establishing such a model is a goal of this dissertation.

According to Kramer & Maughan (2001) all institutions of higher education have developed some common IT infrastructure components as shown in Figure 5. Assessment of the maturity and qualities of IT infrastructure is essential and needs to be ongoing as Chester suggests (2006). “IT remains an immature and rapidly evolving field in which significant changes occur every decade” (Kramer & Maughan, 2001, p. 5). Over the last decade, it has become clear that functional IT infrastructure is composed of more than hardware and software.

Wada & King (2001) conclude that accepting an inclusive model of IT infrastructure incorporating not only the technical assets but also the human process and

organizational elements regarding policies is necessary (p.15).

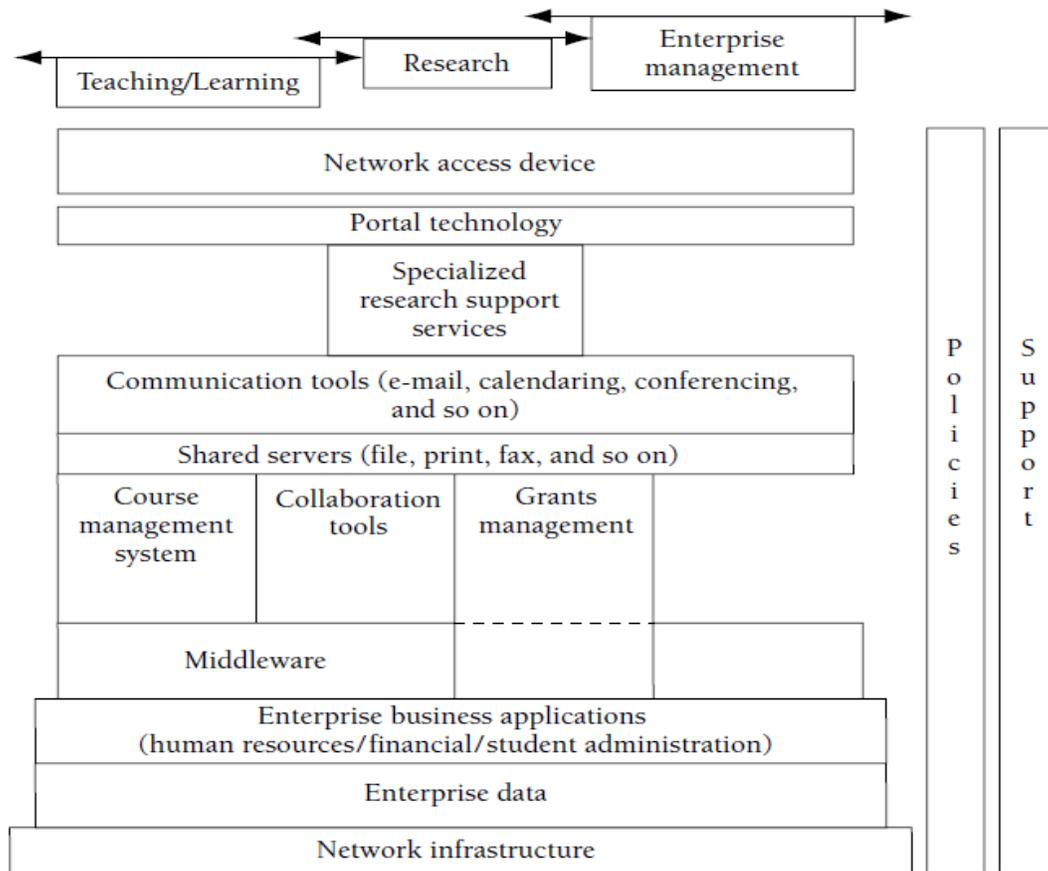


Figure 5. Components of the Modern Campus (Kramer & Maughan, 2001, p. 13) of which IT consists.

A broad description allows for a dynamic evolution of the academic community as technology proceeds, yet sufficient specificity is required if any practical value is to be gained.

Support for Academic Computing Model (SAC)

I have decided to use a logic model in this dissertation project because it is a snapshot of both applications and desired outcomes. Logic Models are a useful framework for examining intended outcomes because they display steps of progress and

develop a realistic picture of what the program can expect to accomplish (Hatry, 1996, p. 38). They are also known as display models.

A program logic model is a description of how the program theoretically works to achieve benefits for participants. Logic models help identify the key program components that must be tracked to assess the programs' effectiveness (Hatry, 1996, p. 38).

I am proposing a logic model diagram, the Support for Academic Computing Model (SAC), see Figure 6, for describing aspects of the ideal *minimal* academic computing program. It includes three components that will be within the scope of my research drawn from the literature: Productivity/Content Creation/Research Tools, Learning/Course Management Systems (LMS/CMS), and Instructional Media Tools. I will be evaluating these services and how they are utilized at both colleges identified for my study. The SAC model is intended to describe the first node, part A, of Figure 1.

Note that at least two other areas, Distance Learning and Professional Development/Training programs, also can be important aspects of academic computing. They are beyond the scope of my research and will not be evaluated here. The degree and importance of distance learning varies greatly with the goals of the particular institution or institutional unit. Professional development involves numerous elements and institutional factors beyond the scope of this dissertation, but could be the subject of an additional extension project should the SAC model prove useful for the three base areas for which it is developed here.

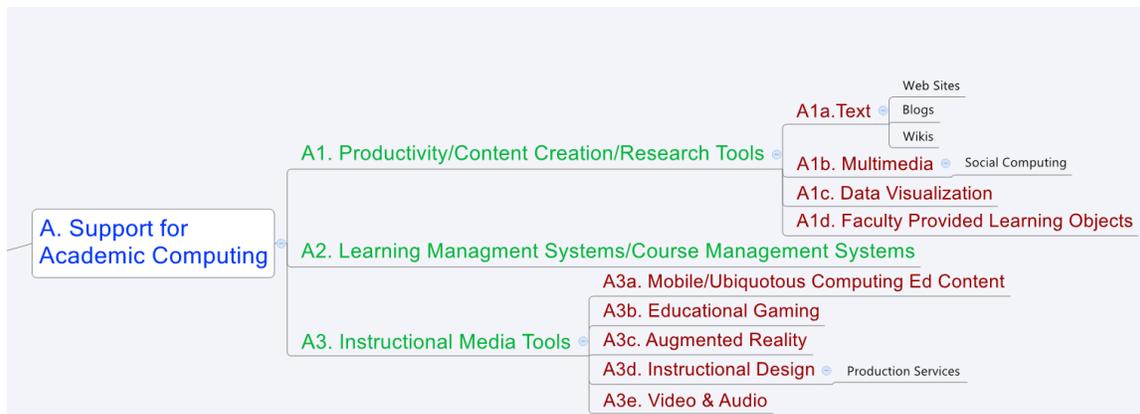


Figure 6. Components in Support for Academic Computing (Logic Model), as component A of the diagram in Figure 1. This is the minimal model that I will be using as a baseline to evaluate what technology exists in the colleges. All institutions should have a minimal model as a baseline in place for IT to function properly.

Productivity/Content Creation/Research Tools, Learning/Course Management Systems (LMS/CMS), and Instructional Media Tools are all mission critical components that support academic computing. Tools for content creation that lead to productivity and research are imperative at a research institution. Learning or Course Management Systems exist in one shape or form in nearly all modern post-secondary organizations and serve to disseminate information and administer courses, as well as potentially providing assessments for students,, bringing them together for collaborative virtual experiences, providing tools for sharing work, and allowing students to participate for learning in social media. Instructional Media tools involve rich media capabilities to enhance instruction, and are represented here in the SAC by five modalities, ranging from new media of video and audio enhancements, virtual instructional design, mobile computing, augmented reality, and educational gaming.

The minimal model is described and used for this investigation in order to help universities consider how they can evaluate a *baseline* condition for academic technology

support that should be implemented across contexts. Institutions at which academic computing is the primary focus of the mission may have more elaborate tools and infrastructure, as well as accompanying support. There can be more complex models developed to capture many more technologies, but my goal is to establish a representative current baseline using the evaluation practices here that can be used as a starting point. Due to many factors, the academic computing model of various schools and colleges may look different, investing more in one area than another, or based on the needs of the faculty, staff and students. However there is some level of interconnectivity amongst all areas in Figure 6. I will be covering the areas in this figure in detail in the next subsections of this chapter that entail descriptions from the literature contributing to the existence of the model.

This evaluative study also investigates whether such a baseline can generalize over the two case study sites. Even should a baseline logic model prove helpful, additional services and infrastructure could be added, or grown over time as resources are available or needs present particular to the setting.

One issue that will *not* be fully addressed here, and will be considered outside of the scope of this case study, is how or whether such a baseline model can be expected to evolve effectively over time. This will be considered in Chapter IV of the dissertation under implications for future work. Such implications depend in part on findings of the research questions here.

The remaining portion of Chapter I will review the Support for Academic Computing Model (SAC) components and examples used at institutions.

A1. Productivity/Content Creation/Research tools.

Teachers must perceive a powerful benefit from technology in terms of learning, improved productivity, automation, and/or efficiency for technology implementation to occur (*Formative Evaluation for Implementation*, p.57). Technology has in many cases increased productivity and efficient outcomes. In this section I will describe “Productivity” tools as those that enhance content creation and delivery of instructional materials or improve productivity for research and scholarship.

Since first developed in the 1940’s, the capabilities of computers have expanded in function, progressing from numerical calculators to data processors, to productivity enhancers, to information managers, to communications channels, to pervasive media for individual and collective expression, experience, and interpretation, and now with embedded learning analytics. As productivity enhancers, past visions of technology in teaching and learning largely reflect using ICT as a means of increasing the effectiveness of traditional instructional approaches. This includes enhancing productivity through tools such as word processors, aiding communication through channels such as email and threaded asynchronous discussions, and expanding access to information via web browsers and streaming video (Dede, p.12).

From a research perspective regarding productivity enhancers, faculty can readily acquire material for research in many fields and gain in their work via productive instruments with the use of collaborative writing and research tools, data analysis software packages, and online repositories and portfolios.

The open content movement focuses on sharing reusable educational content. The goal is offering an alternative to traditionally published materials such as textbooks. This

is accomplished by a community of contributors and users who create high-quality educational content in a variety of media at little cost. A positive effect of open content has been an increase in the availability of information to students and independent learners. Consequently the role of the teacher is changing from distributor of knowledge to a coach for learners to filter resources. Students have a great deal of access to learning materials. Teachers now need to help to cultivate the skills of finding, assessing, interpreting, and synthesizing information (NMC Horizon Project: 2010 Preview, p.3)

With content creation, Web 1.0 is considered static information posting and repositories, Web 2.0 adds the social media element and collaborative tools, and Web 3.0 incorporates the semantic web with data analytics and intelligent agents. From a Web 1.0 view, online networks with webware suites such as Zoho Office and Google Docs offer many of the productivity tools that off-the-shelf packages once provided more exclusively including word processing, spreadsheets, presentation tools and more –all without the need to buy or install any software. It can be easy and efficient to access content online via internet connection. Documents and other content created with these tools are easily sharable for collaborative creation. Many web-based productivity applications also import from and export to standard file formats (The Horizon Report, 2008, p.2), and are easily exchangeable across different suites of tools.

Dynamic knowledge creation, social computing tools and processes are becoming more widespread and accepted. Tools for working collaboratively at a distance are easier to use and more commonly available than in previous years. Online conferences are a convenient form of professional development. As tools have matured, so too have the practices of online communication and collaboration. The collaborative trend is at the

heart of social computing driving personal broadcasting (The Horizon Report, 2006.p3). The interoperability of these tools can enhance productivity among users, and allow groups of students to more readily tap into shared intellectual capital.

User-authoring systems such as presentation software, authored simulations and authored assessments allow instructors to use “on-screen tools (menus, prompts and icons) that let users enter text, compose graphics, and prescribe branching” (Locatis & Al-Nuaim, 1999, p. 66). These tools in turn make content dynamic, which can allow students to better engage with interactive material if the tools work well, are reliable and well understood. With its instructional context, these authoring systems allow teachers to design their own lessons with forms and templates, select different functions of an application based on need, and choose content from reference tools. Because authoring is in the hands of the individual instructor, students experience more personalized instruction. The instructional design for user-authored systems concentrates on creating a usable environment where instructors are guided to construct lessons (American Journal of Evaluation, 2004).

A1a. Text – (Web pages/Blogs/Wikis). Higher education researchers describe how universities need to provide formal instruction in informational, visual, and technological literacy. Specifically, institutions need to encourage the creation of meaningful content with today’s tools (Horizon Report 2008, p. 6). Another group of instructional technology researchers are supporting sociocultural approaches to learning and are specifically interested in the role of the community in learning. Human-to-human interactions are not niceties that make learning more interesting or fun, they describe. Rather, such technologies can improve every kind of learning. Even rote memorization

can require complex social negotiations and structures to establish norms for what is to be learned and to support the development of meaningful understanding. Technologies include wikis, blogs, and other collaborative media (Wiley, 2002, p.17). Schools, colleges and universities have developed the Internet infrastructure of their choice - almost all have web pages, most have online courses, and many have synchronous online learning, to which the collaborative suites of tools are rapidly being added and applied.

The traditional approach to e-learning tends to be structured around courses, timetables, and testing. That is an approach that is too often driven by the needs of the institution rather than the individual learner. In contrast, e-learning 2.0 takes a 'small pieces, loosely joined' approach that combines the use of discrete but complementary tools and web services - such as blogs, wikis, and other social software - to support the creation of ad-hoc learning communities (Downes, 2006, p.413).

It is no longer unusual to attend a conference online or to contribute to a project wiki. As the tools have matured, the practice of online communication and collaboration has increased. This trend is at the heart of social computing and is driving personal broadcasting as well. (Horizon Report 2006, p.5) Using blogs, wikis, or group writing tools, students and researchers can review, edit, and comment on each other's work, create an archive of resources and reference materials, or write a collaborative document (Horizon Report 2006, p.9).

New scholarly methods of authoring, publishing, and researching continue to emerge but appropriate metrics for evaluation fail. These forms of peer review and approval entail reader ratings, inclusion in and mention by influential blogs, tagging, and re-tweeting, All of these approaches are becoming increasingly important in learning settings (Horizon Report, 2010, p.8).

The growing use of Web 2.0 and social networking is changing ideas of scholarly contribution and community. The abundance of tools that enable co-creation, mashups, remixes, and instant self-publication may call the traditional model of academic publication into question and has implications for tenure and merit systems, the Horizon reports describe. Web 2.0 and social networking tools are increasingly being adopted for educational use. Researchers are beginning to tap into the collective intelligence that resides in data generated from Internet search patterns, declared social connections, and purchases on Amazon.com. Tools to record, discover and manipulate data already collected make it possible for anyone to search these datasets and allow amateurs to evaluate data and create sophisticated graphs or other visual representations. Taken together, the increased use of these technologies indicates a steady change in the way scholarship is undertaken and perceived (Horizon Report, 2008, p. 5).

Trends indicate that this transformation from print and analog to digital has happened very quickly relative to the traditional pace of change in higher education. The number of technology-savvy faculty interested in and capable of producing and publishing valuable digital learning content continues to grow. Institutions that provide mechanisms to support the publication and distribution of copyrighted digital learning materials and that account for and distribute royalties on behalf of faculty will have a significant advantage over those that do not (McElroy & Beckerman, 2003, p. 2).

At the University of Oregon, for instance, the Technology Transfer Services this year changed their name to Innovation Partnership Services, which handles technological publication affairs. Many institutions will also want to sustain innovative teaching initiatives by supporting faculty and institutional publishing efforts in addition to

marketing campus-sponsored web-based digital content that may have revenue-generating value. (McElroy & Beckerman, 2003, p. 3). The library hosts and maintains Scholars Bank, which encourages users to submit to such locally supported repositories.

Relevance for teaching, learning & creative expression. Open content lends itself well to teachers for quick customization while keeping up with emerging information and ideas. Communities of practice and learner groups that form around open content provide a source of support for independent or life-long learners (NMC Horizon Project: 2010 Preview, p. 3). IT has increasingly transformed the research environment.

With the mission of life-long learning, the research environment is constantly by its nature advancing. “Support is perhaps the most critical, and the most difficult, component of a campus technology architecture” (Kramer & Maughan, 2001, p.15). When IT is implemented effectively, it enhances the function of the institution towards better achieving the department’s mission (Kramer & Maughan, 2001), hence the importance of an effective IT support unit. Significant changes will be in end-user utilization, which will determine what academic computing services are available. “Educators will be able to share resources such as distributed computers, large data repositories, and remote instruments without regard to geographic location” (Blatecky, A. West, A. & Spada, M., 2002, p. 35). Therefore, Chester (2006) suggests that it will be very important to have a process for decision makers and end-users to ensure the best use of academic leadership that builds services, transforms teaching and learning with the proper utilization of tools (p. 58). With increasing means for support, research efforts can be accommodated.

Researchers described that despite the challenges, “the computing environment has grown in positive ways—higher-caliber hardware and software, evolving methods of communication, and large quantities of accurate online information content” (Vaughan, 2004, p.153). With the increase in computing power, the research potential at universities has also been enhanced. The National Science Foundation (NSF) supports a vision for the future of research that centers on “cyberinfrastructure,” or the integration of computing, data and networks, digitally enabled sensors, observatories and experimental facilities, and an interoperable suite of software and middleware services and tools (National Science Foundation Cyberinfrastructure Council [NSFCC], 2006). Sophisticated simulation software and wireless observation networks have enabled the exploration of many phenomena that cannot be studied through conventional experimental methods. Research in the sciences relies increasingly on computational models to understand topics such as genetic decoding, weather prediction, and information security.

Cyberinfrastructures developed for research purposes create intriguing opportunities to transform education. Scientific and educational resources are accessible in a wide variety of settings, rather than specialized locations. Real-time data collection enables assessment of students’ educational gains on a formative basis to provide insights into their progress. Extensive “online” learning complements conventional face-to-face education, and ubiquitous, pervasive computing infuses smart-sensors and computational access throughout the physical and social environment (Dede, 2007, p. 32). Accomplishing these shifts requires a reinvention of ICT’s role in education beyond than the creation and maintenance of the cyberinfrastructure itself (NSFCC, p. 32).

A1b. Multimedia - Social Computing. Contrasted to the historic pattern of lifestyles that centered on face-to-face interactions with local resources, people who today share the same dwelling may have different personal communities as their major sources of sociability, support, information, sense of belonging, and social identity (Rheingold, 2002). Social computing can assist effective knowledge generation, knowledge sharing, collaboration, learning and collective decision-making concepts. Essentially, social computing refers the application of computer technology to facilitate collaboration. The emphasis is on the social part of social computing, which makes this phenomenon interesting. Social computing is long-lasting in the way it facilitates an almost spontaneous development of communities who share similar interests. In part this change has been driven by the widespread acceptance and use of the tools that make social computing possible, but it has also resulted from an atmosphere of openness to the kinds of activities that can take place. Professionals are increasingly willing to take part in meetings and conferences online, and to work in distributed groups that may meet in person only a few times per year. Venues for virtual meetings have matured, making the experience of working together online easier and more pleasant. It is not uncommon to make substantive connections with people online, making_it possible to develop extensive personal and professional networks. Social computing interactions have transferred into the world of education. Many students are familiar with tools for working together and sharing knowledge and information, like Flickr, an online community for sharing photographs; instant messenger, for getting quick answers to questions and arranging get-togethers; or Skype, for inexpensive voice-over-IP conversations in realtime. Some

students bring these tools to campus and continue to integrate them into their patterns of daily life and work, or share them with others.

The emerging aspect of social computing that develops alongside online communities is the way that formal taxonomies for information have formed into “folksonomies.” Instead of a scholar designing a taxonomy for describing web resources on a given topic, a folksonomy—a collection of tags defined by people in the community of interest—emerges spontaneously from members of the community. Simply by applying tags that make sense and using tools that allow commonly applied tags to float to the surface, the community develops its own sorting and ranking criteria for materials of interest. Because of sophisticated computers and telecommunications, the process of individual and collective thought is increasingly dispersed symbolically, socially, and physically. For better or worse, entertainment and human interaction are delocalizing too. In social constructivism, students construct knowledge as a result of interactions with their community (Edelson, Pea, & Gomez, 1996). Some scholars (Pear & Crone-Todd, 2001) identify the scientific research community as an example of social constructivism since researchers construct original ideas to share with peers, and through these interactions, reformulate their knowledge. David Wiley of Utah State University led a discussion on the sustainability of learning communities and the importance of including aspects of socialization in various projects. Wiley urged his audience to consider how to go about scaling their works. His paper in "The Coming Collision between Automated Instruction and Social Constructivism" provides a provocative examination of scalable, social learning environments in current use on the Web. (Wiley, 2003, p. 6) Utilizing the concept that the understanding of the mind is a social product through various

interactions, knowledge becomes knowledge through social process, some scholars claim (Anderson, 1996, p.12).

Relevance for Teaching, Learning & Creative Expression. Social computing practices have definite applications for distance learning and training. Due to advances such as synchronous meeting rooms that take advantage of voice-over-IP or video capabilities, taking courses at a distance in some settings has come to enable some of the interactions possible in face-to-face courses. Conferences take place without the expense of travel—and with the added benefit of an online archive of conference materials after the event’s conclusion. Applications like these are already taking place in educational settings. Of interest for the near future is the potential of folksonomic tools to transform the way we label and find articles, resources, and other materials. Just as tools like Flickr, Facebook, del.icio.us and others have replaced taxonomies and ontologies in social networking contexts, it is anticipated that folksonomic tools will allow researchers to dynamically create coding and classification schema that reflect the collective wisdom of their community. College websites incorporating such tools use tags created by users to enable sophisticated non-linear browsing, searching, and finding based on user perceptions and needs. Tagging by members of a specific learning community (such as students in a particular course) could lead to a course-specific language or a kind of shorthand for complex topics, which would enrich discussion and increase a feeling of community instead of isolated learning.

Of course, determining the relative value of any particular piece of information or media is necessary given the expanding amount of material available on the Internet. One way to do this is to review the opinions of trusted friends and colleagues; folksonomic

tools make this possible. By tagging the good and ignoring the bad, the community makes it easier to find useful material. This process may have application to teaching, learning, and research, as well as to creative expression. The easier it is to find something, the easier is it to reuse it (The Horizon Report, 2006, pp.5-6), within the limitations of the novice expertise that may have been applied to originate the understandings that have evolved.

A1c. Data visualization. Data visualization is the use of tools to represent data in the form of charts, maps, tag clouds, animations, or any graphical display that makes information easier to understand. “Recent years have seen a blossoming of visualization applications, as well as of technologies and infrastructure to support increasingly sophisticated visual representations of data” (EDUCAUSE, 2009. p.1). A variety of tools extract data from large datasets and display it in new ways. These tools present data in forms that make patterns more intuitive to understand (EDUCAUSE, 2009. p.1).

Many Eyes, Wordle, Flowing Data, and Gapminder are online services that accept data and allow the user to configure the output. Capturing and visualizing student data may enable teachers to make better decisions about what and how they teach. Using these tools for educational data will make it easier to understand where programs are successful and the necessary improvements.

“Graphic representations of data are popular because they open up the way we think about data, reveal hidden patterns, and highlight connections between elements” (EDUCAUSE, 2009. p.2). Using such tools can simplify the interpretation of complex data sets for cross-disciplinary purposes. Wordle and tools such as in Many Eyes create visual montages of words, sentences, phrases, or paragraphs uploaded and processed so that the

audience examining the end result sees text or other data in a new light (EDUCAUSE, 2009, p.2).

Relevance for teaching, learning & creative expression. For scholars visualization offers the promise of easier communication and a wider audience for their findings. With Wordle, students analyze papers, receive immediate feedback concerning points that need further development, and locate where certain language has been overused (Horizon Report 2010, p.7). Educators can present their points in an increasingly engaging form, and students making presentations or delivering papers have the opportunity to graphically incorporate data to make points that their peers can easily understand (EDUCAUSE, 2009, p.2). New mobile apps for data visualization are Roambi and SimpleMind Xpress. And Harvard scientists use data visualization to measure the expansion velocity of the supernova remnant Chandra. (Horizon Report 2010, p.7). There are a plethora of methods for visualizing data.

A1d. Faculty-Provided Learning Objects. Visuals are powerful for their compact details. A "learning object" is "any digital resource that can be reused to mediate learning" (Wiley & Edwards, 2002). Faculty-Provided Learning Objects are deliverables that faculty share with students as course content. These learning objects can serve from a static concept map to dynamic interactive media. In a literal sense they are objects used to aid students in learning a concept. "The two main goals behind learning objects research and development are to improve the economics of online instruction and to enable pedagogical innovation" (Wiley, 2003, p.18). These two goals may not be equal in importance in the minds of learning objects researchers. The highest demand often is for the creation of images, which itself is a recognition that the web is a far more

visual based medium and that the use of images is the first area where staff may encounter copyright problems (ETNA, 2007, p.30). Methods that engage the senses and include relaying information visually, in audio, and kinesthetically tend to produce improved instructional outcomes for some learners (Izzo, Hertzfeld, & Aaron, 2001) (Izzo, Murray, & Novak, p. 30).

Relevance for teaching, learning & creative expression. As it turns out, "teacher bandwidth," or the number of students an individual teacher can serve, can be one of the most significant bottlenecks in online learning spaces. Like much of the computer-based instruction research before it, learning objects research has described various ways in which automated systems can assist instructors (e.g., Martinez, 2002; Merrill, 2002; Hodgins, 2002). Like other pieces of software, this step to an automated system of assistance tools, which can be sold and distributed electronically, moves instructional technology companies into the area of "write it once, sell it often" economics, which has transformed companies like Microsoft and Oracle into commercial powerhouses. At an extreme, the interest of automation is represented by a statement of purpose from the Institute of Electrical and Electronics Engineers (IEEE)'s *Learning Technology Standards Committee's* Learning Objects Metadata specification: "To enable computer agents to automatically and dynamically compose personalized lessons for an individual learner." Complaints regarding online instruction often center around notions of both the importance of the teacher's role and concern for learner isolation and dehumanization of learning. However, the onset of Web 2.0 and social media have altered the perspective, drawing attention to how technology can now be all about the student-student and student-teacher interactions, empowered to new levels and forms. Wiley and Edwards

(2003) questioned, "Why would we put learners in front of the most advanced communications system of all time and not have them communicating?" (Wiley & Edwards, 2002). An immediate interest in learning objects is the ability to build new pedagogies on top of the learning objects platform.

A2. Learning Management Systems/Course Management Systems.

In many respects, the learning management system (LMS) has become a commodity business. Educational software of all sorts abound and the need for some integration into coherent systems has spread worldwide (Downes, 2006, p. 412). The course management system (CMS) - a software program that provides a set of integrated tools for assessment and evaluation, content management and delivery, communication and collaboration and course administration - has increased institutional capacity for delivering web-based learning. Course management systems have been recognized as a key technology for delivering courses and programs (Katz, 2003; Gallagher, 2003), have appeared on the list of top 10 issues that Chief Information Officers/IT executives have to resolve for a campus' strategic success (Crawford et al., 2002), and their use is cited as an effective practice for redesigning courses for increased quality and cost savings (Twigg, 2003). Because tools are generic, use of a CMS cuts across disciplines and sectors. The CMS represents an opportunity and a challenge. Large numbers of faculty are placing a variety of course assets such as lecture notes, presentations, publications, online textbooks, multimedia activities, sets of web links, assignments, and tests into CMS shells. Millions of students are participating in discussions, taking tests, turning in assignments, and developing portfolios. The amount of intellectual capital that is resident in CMS sites worldwide is astounding. Associated with this reservoir of content is an

even deeper - and more important, largely underappreciated - well of faculty pedagogical expertise.

With their large user bases, there is tremendous potential for the CMS to form a basis for exchanging content and best practices. However, while more faculty and programs have come to rely upon course management systems over the past few years, rapid technology and business changes (mergers, elimination of products, etc.) and shifting policy grounds have brought about a sense of discomfort in the community (Wiley, 2003, p. 59). In the mid 1990s, inspired by the release of the graphical browser, computer-savvy faculty learned how to develop web pages and put together extensive course web sites. The promise of this new medium was tantalizing for making content and communication possible in new ways. At new times, students could be reached in different ways and could be provided the tools to take more control of their environment. However, to add interactive components like discussion boards or quizzes, a high technical skill level was required. Course Management Systems emerged during this period in response to the need for a practical way for normal faculty members to use the web. Bender (2003), in the ECAR Research Bulletin, "Student-Centered Learning: A Personal Journal," outlines how the emergence of the course management system affected his course environment:

With a CMS, all of the "tools" of the classroom, from document archives to assignments and session notes to gradebooks and rosters, are integrated through a single platform. For the first time, students understand that the distinct elements of their coursework form a complete learning experience because they see the interrelationships through the window of the CMS (p. 3).

The CMS facilitates a striking reduction in the need for maintaining and supporting multiple platforms to address specific pedagogical purposes. CMS connections to other

campus systems also exist, for instance for automated student registration (Wiley, 2003, p.61).

At the same time, it is important to be able to share a learning module (as defined by a content package of some type) between courses or platforms. Content can be developed with standards-compliant tools outside of the CMS, and importing of the modules with tools made available by the CMS. Instructors can modify and enhance content with the specialized tools that are uniquely available within a CMS. To accommodate this capacity, the major CMS vendors are partnering with content creation tool providers (e.g., Macromedia) and a variety of Learning Content Management Systems (Lamberson & Lamb, *Course Management Systems*, p.70).

Relevance for teaching, learning & creative expression. By stimulating the discovery of new knowledge and the development of new learning tools for students, web-based information technologies have a profound impact on higher education research and teaching programs. Information technology standards have emerged to provide students with “anytime, anyplace, and at any pace” learning environments that innovative teachers and institutions had long envisioned for the Internet. The foundation for web-based learning created a dramatic growth in demand for digital content at higher educational institutions. Digital content scope requirements are complex; however, the higher educational community’s management problems are unique. Under instructor direction, students acquire the digital content recommended or required for coursework. Instructional materials have traditionally consisted of textbooks available from the campus bookstore or library. (McElroy& Beckerman, 2003, p.1). Many faculty now use Course Management Systems to disseminate material. Digital resources, specifically

web-based learning content, are a growing and pervasive component of instructional delivery in higher education.

A3. Instructional Media Tools.

There are a multitude of tools being utilized, thus the model will be highlighting the most prominent five in instructional technology.

A3a. Mobile/Ubiquitous Computing Ed Content. Mobile phone technology includes a variety of software and productivity tools, which are being used to store and access useful reference materials. (The Horizon Report, 2006, p. 15). Wireless mobile devices support social interactivity, are sensitive to shifts in context, enable individualized scaffolding, and facilitate cognition distributed among people, tools, and contexts (Klopfer & Squire, in press). The mobile market today has billions of subscribers, where a large base live in developing countries. Over a billion new phones are produced each year, and the fastest-growing sales segment belongs to smart phones — which means that a massive and increasing number of people worldwide now own and use a computer that fits in their hands (The Horizon Report, 2010, p.2). Applications make mobiles/smart phones such a vital part of people’s lives. Tools for study, productivity and task management have become integrated with online applications and their mobile counterparts. Blackboard has a mobile application that gives students access to course materials, discussions, assignments and grades. Mobiles and handheld devices are commonly carried making it easier to remain connected anytime and anywhere.

Smaller and less expensive than a laptop, yet just as useful, the mobile is fast becoming the ultimate portable computer. Mobile blogs (called moblogs), currently allow individuals with Internet enabled camera phones to instantly submit photo images from

phones directly to moblogs. Users record sound with their phones and submit to specific sites that turn the file into a podcast. The new generation of videophones will naturally encourage the same process for video (Meng, 2005,p.9). In 2006, multimedia capture came to mobile phones, which brought the capability to record and play video, audio and still imagery. Almost immediately, mobiles for many early adopters were established as the storehouse of digital lives, holding calendars, to-do lists, photo and music collections, contact databases and more. Driven by the innovation only possible in a market where more than 900 million devices are built each year, the feature sets of mobile phones have expanded enormously.

Today, mobiles are increasingly about networking on-the-go. Better displays and new interfaces make it easier to interact with an ever-expanding variety of content—not just content formatted specifically for mobiles, but nearly any content available on the Internet. Mobiles now keep users connected in almost all ways laptops do, albeit often with more limited functionality, for email, web browsing, photos and videos, documents, searching and shopping — all available anywhere without the need to find a hotspot or power outlet. Newer, longer-lasting batteries keep mobiles alive for longer durations between charges. New push technology allows manufacturers to send updates directly to devices. Open Application Programming Interfaces (APIs) encourage the creation of custom widgets that offer even more services; combined with webware applications that already exist, the capabilities of mobiles often rival much larger computers (Horizon Report Preview 2008, © 2007 The New Media Consortium, p.3).

Higher education faces a growing expectation to deliver services, content and media to mobile and personal devices. As new devices are released, the demand for

mobile content will continue to grow. Recent infrastructure changes have resulted in increased access areas for mobile devices. There are clear applications of mobile technology for public safety, education, and entertainment. The increase in transferable mobile applications is more than merely an expectation to provide content: accessibility yields an opportunity for higher education to reach its constituents wherever they may be (Horizon Report Preview 2008, © 2007 The New Media Consortium, p.6). Ubiquitous video capturing, editing and sharing has never been so easy. In January 2007 alone, 7.2 billion videos were viewed online by nearly 123 million Americans. Online video viewing comprises 70 percent of the total U.S. Internet audience (Horizon Report Preview 2008, © 2007 The New Media Consortium, p. 2).

Relevance for teaching, learning & creative expression. Tablet Personal Computers (PCs) record and analyze field research, due to their portability. Many universities are making courses available for mobile delivery. Medical students use smart phones to check H1N1 updates from the Center for Disease Control (NMC Horizon Project: 2010 Preview © 2009 The New Media Consortium, p 2). Klopfer & Squire and Dede (2007) cite how mobile devices support social interactivity, are sensitive to shifts in context, enable individualized scaffolding, and facilitate cognition distributed among people, tools, and contexts. Mobile and personal technology are increasingly viewed as a delivery platform for services of all kinds. The ubiquity of these devices have enabled personal broadcasting (podcasting and vlogging) to take off almost overnight. That is just the “first wave” of broadband content that will be ported to cell phones (The Horizon Report, 2006, p. 3)

A3b. Educational Gaming. A recent surge in educational gaming has led to increased research in gaming and engagement theory - namely: the effect of using games in practice and the structure of cooperation in game-play. The serious implications of gaming are still unfolding (Horizon Report, 2006, p. 7). By studying the principles of game design, educators are learning more about how to package and deliver content to facilitate comprehension and retention. Educational gaming is a growing field with serious implications for adult learning that we are only now beginning to understand.

Starting in approximately 2006, there has been a subtle shift in the way educational gaming is perceived in higher education. A number of interesting examples have shown that games can be effective learning tools. As a result, there is greater interest among scholars to not only quantify the actual effect of games on learning, but also to define the essence of gaming itself in order to better apply its principles to education. Educational gaming is no longer a fringe activity pursued exclusively by extreme technophiles—it is emerging as a multifaceted and rich discipline unto itself. Degree programs are springing up in game design theory, a subject that has not traditionally been among program offerings in higher education. For game programmers, courses range from mathematics to ethics in cyberspace to storyboarding and character sculpting. Certainly programs embrace the technical considerations of game creation. The theoretical aspects of gameplay - the ideas that have implications for all kinds of educational activities - are beginning to receive an equal share of attention. By studying successful consumer games, such as massively multiplayer online, console, board, and physical, researchers tease out the basic principles of gaming that lead to engagement and

success. Such principles may be applied to development of educational and non-game educational materials.

Further research in educational games is warranted, of course, but the possibilities are intriguing. Imagine a set of curricular materials that are as approachable—and as hard to put down—as your favorite game, but contain solid educational content. The complexity of the discipline is reflected in the array of activities that fall under the umbrella of educational gaming. Consider just a few of the many types of games that are being explored in terms of their educational potential: simulations, virtual environments, social and cooperative play, and alternative reality games.

Based on complex mathematical formula that operate on large data sets, simulations allow repeated practice of difficult procedures or experience with delicate and complex equipment. Common uses include flight training, medical applications, and conflict resolution. Creation of simulations is as educational as its uses are. Skills in mathematics, statistics, and domain knowledge of the field being modeled are required in order to accurately model a real-life process.

The popularity of consumer games like Second Life and World of Warcraft has its basis in its visually rich and engaging environment. The engines that are used to create virtual environments are like a set of drawing tools: they are inherently theme-independent and can be used to create any kind of world that is desired. A number of projects are underway to develop open-source gaming engines for educational use that can recreate ancient spaces, develop models of campuses, or bring remote ecosystems right to your computer for study.

Online or off, one appealing aspect common to many games is player interaction. Whether competitive or cooperative, social interactions during game-play offer a rich source for study by game theorists. While face-to-face cooperative play has been the subject of scholarly studies for several years, a new facet is being explored as researchers venture into the world of massively multiplayer online role-playing games (MMORPGs) to study the interactions that take place there.

Mixing game-play and real life, alternative reality games challenge players to critically examine events that appear real. The object of such games is to discover and solve a mystery. This type of game operates in both space and time, often taking months to complete by involving online clues in public spaces and in personal emails.

Orchestrating such an experience is demanding. The puppet masters, as the game designers are called, must conceive of the mystery, design and plant clues, and monitor players' progress. Such games are only a sampling of the kinds of games that are being studied for potential learning applications. The power of gaming to engage learners of all ages marks this emerging discipline as one of special import for education.

Relevance for teaching, learning & creative expression. Games can be applied across the curriculum and research is continually uncovering new uses. Using games in practice helps present concepts in interesting ways, makes topics more approachable to the novice learner, and provides new opportunities for collaboration and competition among learners. One aspect of gaming that makes it so flexible as a tool for teaching and learning is the way it can be approached, from the angle of game creation as well as play. A significant level of research is required to develop a compelling game. Depending on the kind of game, detailed statistics, descriptions, measurements and historical data must

be gathered and assimilated to inform development of the game environment. At the College of New Jersey, the new Game Design Program addresses this by offering a year-long multidisciplinary learning experience in which students collaborate across disciplines to develop a multiplayer online game. Students learn to understand and appreciate concepts outside of their own areas of expertise while developing advanced skills in their chosen fields (Horizon Report, 2006, pp.17-19).

A3c. Augmented Reality. Augmented reality interfaces enable “ubiquitous computing” models. “The term augmented reality (AR) was first coined in 1990 by former Boeing researcher, Tom Caudell” (The Horizon Report, 2010, p.3). The approach is to augment location-based data accessed on the web with what one sees in the real world. Mobile devices are offering this capability. With the rise of smartphones containing high-quality cameras and GPS capabilities, AR is more prevalent. Streamlined approaches allows for wider adoption. Currently most AR is based in entertainment and marketing.

Augmented reality has strong potential to provide both powerful contextual situational learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world (The Horizon Report, 2010, p.3). AR gaming is based in the real world augmented with various networked data, giving gamers and educators powerful new ways to show relationships and connections that are relatable in reality. Students carrying mobile wireless devices through real world contexts engage with virtual information superimposed on physical landscapes (such as a tree describing its botanical characteristics or an historic photograph offering a contrast with the present scene). This type of mediated immersion infuses digital resources throughout the real

world, augmenting students' experiences and interactions. Researchers are beginning to study how these models for learning aid students' engagement and understanding (Klopfer et al, 2004; Klopfer & Squire, in press). Augmented reality (sometimes called annotated reality) overlays information onto the real world, supplementing what can be seen with what is hidden. Enhanced visualization creates a three-dimensional experience based on a set of data, bringing the information to life in a way that makes it almost physically present. Both have the power to transform understanding, and both may have greater implications for education in the coming years.

Well underway in multiple programs, augmented reality and enhanced visualization techniques offer dramatic new ways to use visual comprehension skills to explore complex phenomena, situations and relationships. Large data sets can be experienced as three-dimensional spaces or objects; exact models of anatomical features can be created and held in the hand; systems too small or too large to actually be seen can be scaled up or down, filling a room or fitting on the top of a desk. To be safely examined and manipulated, copies of fragile objects can be printed on rapid prototyping printers. The hidden is made transparent: internal wiring projected onto walls, or a broken bone superimposed on the outside of a leg. A very simple example is common in language classrooms, where objects are labeled with their names in the language of study. Some applications of augmented reality require special glasses that display information as the wearer looks around (like those used for night vision). The kind of information shown and the way it is displayed varies by context from text lists, statistics to diagrams and drawings.

Enhanced visualization takes a different approach: instead of overlaying data onto the real world, a new representation is created from data. For example, based on seismic data of an oil field, a visualization of the entire field can be created and scaled down to room-size. Looking at this field, engineers can determine the best way to reach oil before any equipment is installed in the field itself. Rapid prototyping printers are another enhanced visualization device. By sending a large dataset to the printer - the makeup of a complex molecule or the specifications for a new aircraft - a physical scale model is created that can be handled and examined. Both use the same underlying technology to approach data in a new way. With enhanced visualization something is created without its actual physical existence.

Relevance for teaching, learning & creative expression. MIT's Scheller Teacher Education Program is using augmented reality and exploring its potential in a number of disciplines. The program has developed a game called Environmental Detectives using GPS enable devices to uncover the source of a toxic spill. The Four Eyes Lab at the University of California Santa Barbara is engaged in a number of innovative AR research and demonstration projects. AugmentThis! is a mobile service that accepts KML (Google Earth) files, which can be viewed on an Android phone, overlaying the data through the camera on the phone (Horizon Report 2010, p.5). Currently in use in disciplines such as medicine, engineering, and archaeology, these technologies for bringing large data sets to life have the potential to literally change the way students and researchers see the world by creating three-dimensional representations of abstract data (Horizon Report, 2006, p. 7).

While still some years away from broad use in education, augmented reality and enhanced visualization are already used in many disciplines. By offering a visual representation of large data sets, these technologies open the door to new ways of understanding the world. Thus far, augmented reality and enhanced visualization have seen the widest use in military and industrial applications. New uses are beginning to emerge as the underlying technologies are further developed. As the possibility of augmented reality is tantalizing the potential applications span academic disciplines, from history to mathematics and from the arts to the sciences. In disciplines such as archaeology, history, and anthropology, it is already possible to virtually recreate ancient spaces and artifacts for study. Small-scale models of ancient buildings complete with original paintwork have been allowing students to move through the digital spaces. Soon, it may be common to project three-dimensional models at a size that allows students to walk through the projections themselves. The same is true for cultural artifacts; models of ancient utensils can be created three dimensionally or printed on rapid prototyping systems. Modeling can be quite complex.

Under development are human-sized avatars in historically accurate costumes that can be programmed for all sorts of activities, from performing folk dances to speaking in the language and style of a particular time. Life sciences invite exploration with augmented reality. By analyzing the data from ground-penetrating radar and projecting a model over the dig site, for example, paleontologists can best decide how best to retrieve fossils from underground. Consider how field studies could change when students are able to provide information about plants and animals they are observing and

see it alongside the specimen—taking measurements, or comparing a juvenile with a stored image of an adult.

A3d. Instructional Design - Production Services. Digital learning content may take a wide variety of forms, including traditional text but also so-called “rich media” such as audio/video, animations and simulations, easily manipulated by a student. The evolution and expanding pervasiveness of higher bandwidth technologies encourages and supports the development of sophisticated rich media learning content. A robust, secure and scalable technology infrastructure based on new and emerging Internet 2 standards is required to support the current and future service demands of the academic community. The evolving technology requirements of web-based digital content storage and distribution processes need to be in place (McElroy& Beckerman, 2003, p. 7). Learning object issues are concerned with developing technical systems to meet education and training needs.

On the other hand, any system pertaining to deliver learning and training must express its technical construct using concepts of instructional design and pedagogical theories. Learning and teaching are complex environments with many stakeholders including learners, instructors, courseware designers or instructional designers and education managers. Even within the stakeholder group broadly called instructional designers, the pedagogical paradigms reviewed above show as much gap among the paradigms embraced by the participants as between the learning technology and education community. Technical language presents great difficulty for the learning technology community to operationalize any of the concepts in the technical design of a

generic learning object framework. Researchers ask, “Is there one learning environment, which can satisfy all needs?” (Ip et al, 2001. p. 7)

Lastly, while reading is a major activity even online, learning resources are more than just reading material. The ability to support appropriate interaction is important. The current finding is in line with a previous work by Ip & Canale (1997). The authors identified the need of different skills in creating digital learning objects and argued for a clear demarcation of responsibilities among instructional designers, subject matter experts and software designers. Ip & Canale (1997) emphasize that content and functionality are two independent and somewhat orthogonal concepts. Content, contributed mainly by subject matter experts, can be encoded as structured and unstructured resources. Unstructured content can be rendered by generic software such as the web browser or popular plug-ins. Functionality is provided by software (referred to as rendering software), which is necessary to take the structured resource and provide interactivity in an educational environment.

Instructors in secondary and post-secondary institutions use three primary types of learning technology applications: formalized lessons, activities, and user-authored systems. While instructors use technology for other purposes both inside and outside of classrooms, these three categories of educational technology applications are commonly developed by instructional designers, content specialists, engineers, and scientists with the goal of sustained use by teachers and students (Weston, 2004, p. 52). User-authoring systems (Locatis & Al-Nuaim, 1999), such as presentation software, authored simulations, and authored assessments, allow instructors to use “on-screen tools (menus, prompts, icons) that let users enter text, compose graphics, and prescribe branching” (p.

66). Because authoring is at least somewhat in the hands of the user in many of these cases, the eventual instructional product experienced by students can vary.

The instructional design for user-authored systems concentrates on creating a usable “environment” where instructors are guided to produce lessons (Weston, 2004, p.53). Two types of clients typically hire formative evaluators; each has different approaches and priorities that have traditionally limited the scope of formative efforts. Software engineers (and other technical specialists) have largely concentrated on feedback about usability and interface design, with less attention given to design issues that impact the curricular and practical integration of technology. Formative evaluation of usability and interface design examines whether an educational application “works” in a purely instrumental sense, is usable, and has an attractive design (Seidel & Perez, 1994). In contrast, instructional designers and content experts evaluate lessons “delivered” by technology. Evaluation focuses on content and format to make sure that lessons effectively teach and assess their objectives (Dick, 1996). Evaluators typically make recommendations for altered wording of text, clearer directions, more appropriate lesson length and altered lesson sequence. Many projects combine elements of the two approaches as lessons are debugged, user interfaces are improved, and content and format are altered. The strategy of improving interface quality and “tweaking” of content starts early in development and continues through field-testing (Weston, 2004, p.56).

The role of the evaluator as an independent advisor is separate from the role of instructional designer and involves extensive observation of use, interviews with teachers and students, collection of logged data related to duration, frequency, and other records of use. The evaluator actively analyzes and synthesizes evidence, and then makes design

recommendations. Evaluation occurs as teachers and students use applications and lessons as “naturally” as possible for instructional purposes initiated by the instructor (Weston, 2004, p. 58). Critical to any effort is the assessment of relevance of the lesson to the core content of learning goals and objectives, assessments, content narrowness or breadth, and content difficulty.

Relevance for teaching, learning & creative expression. Instructional designers or content experts make decisions about content early in the design process, but the ultimate assessment of fit does not occur until a lesson is implemented. Designs that incorporate embedded instructional methods and pedagogy (e.g., “drill and practice” or “inquiry-based learning”) must also fit with philosophies and practices emphasized by the instructors, and that either satisfy or vary in principled ways from norms in the field of instruction. Assessment of curricular compatibility for formalized curricular products can come through direct analysis of curricular intentions, and review and/or specification with curriculum experts and instructors. In cases where no instructional designer is included on the development project, information about how the innovation fits existing practices can be vital to the project’s success, and it may become the evaluator’s role to help inform on this through needs analysis and literature review (Weston, 2004, p. 60).

A3e. Video & Audio. With roots in text-based media (personal websites and blogs), personal broadcasting of audio and video is a popular trend increasing due to capable portable tools. From podcasting to video blogging (vlogging), personal broadcasting is impacting campuses (Horizon Report 2006, p.7). Informally produced personal audio and video content rapidly moved into academia as a form of personal expression and a means of information delivery. Recording devices for both audio and

video are small, portable and relatively inexpensive, the quality of captured media can be relatively high, and the process of publishing video and audio is becoming easier.

Already it is possible to drop a video clip directly onto a web page, trimming and uploading it in one step. The clip can be embedded in any web page with a few lines of provided code. Audio is equally easy to share: a podcast can be quickly published to the iTunes music store, for example, where it is easily retrieved (Horizon Report 2006, p.11).

Video is easily produced on all manner of inexpensive devices from phones to pocket cameras. Hosting and access for such content is available free in many cases, and educational uses abound (Horizon Report 2008, p.2).

Webcasting, a video counterpart to podcasting, is also growing in popularity. At some universities, certain courses are routinely webcast (video is recorded and streamed live to the web and/or made available as a recording after class), providing students with an archive of each class session for review. Stanford, MIT, and others have made selected seminars freely available online. Vlogging, a form of blogging where the main content is in the form of video clips and text entries serve as annotations, is gaining popularity among bloggers. As devices for recording audio and video have converged with the most ubiquitous personal tool - the cell phone - personal broadcasting has taken off. Thousands of videos with topics from educational materials, personal stories to amateur music and cinema are just a click away for any Internet-connected user. Universities are turning to services like YouTube and iTunes U to host video content, shifting the related infrastructure costs to those services in the process. Hosting services even provide institutional “channels” where content can be collected and branded with the institution’s look.

Small recording devices can be used to capture lectures for later reference but the potential goes far beyond that. Students use their smart phones to record interviews with classmates and faculty, or capture video footage during fieldwork to use the raw recordings to create a multimedia presentation. A collection of clips captured over time and presented in blog format could document the development of a project. Drama faculty at the North Carolina School for the Arts are using iPods to record accent and dialogue for students to study. At Skidmore College, when students in a sculpture class break into project groups, one student in each group is assigned the task of documenting and publishing the group's work with photographs, audio and video. At Johns Hopkins University (JHU), students use an interactive map software application developed at JHU's Center for Educational Resources to collaborate in "digital field experiments." In one multidisciplinary course, students work in teams to study urban issues such as public health, crime, or public art. Using iPods and digital cameras, students record interviews and take photographs and videos in the field. These serve as data organized using the interactive map tool, which allows the students to tell a story and analyze data spatially. To complete the project, students create a National Public Radio (NPR)-like news article using recorded narrative and clips of their interviews (Horizon Report 2006, p.12).

The podcasting phenomenon is a good example of delivering content and has become so widespread. The appeal of the device was increased by its small size and light weight. Utterly portable and popular, the iPod is also incredibly easy to use: adding content is instantaneous. Podcasting provides an easy means for educators to take advantage of this ready-made widely available tool to deliver educational content (Horizon Report 2006, p. 11).

Personal broadcasting is becoming more common in educational settings. Ohio University offers a weekly video podcast (vodcast) series covering a range of technology topics, from how-tos to reviews of current technology. Available on the campus website and also through iTunes, the vodcasts are free to anyone. The Interdisciplinary Center for eLearning (ICE) maintains a blog that discusses technological issues of import to the campus. Another program in the works by ICE, the mLearning (or Mobile Learning) Institute, will train interested faculty who want to incorporate personal broadcasting (video or audio) in their courses. Readings from poetry and literature, in addition to recordings of conversations, can be a podcast for students to become familiar with the sound of the language or to practice dictation. Students could prepare and host a weekly podcast on current events, to be delivered in the language they are studying.

Relevance for teaching, learning & creative expression. Personal broadcasting has applications not only for transmitting content for students' use, but also in having students create content. In terms of prepared content, the increasing presence of ever more capable devices among students, such as today's smart phones has already spurred the creation of podcast content expressly for that platform. Many students who own laptops do not carry them to class because they are bulky and heavy. The content delivery mechanism has been provided for: any mp3 file can be downloaded and copied onto the device. The promise of portable devices is that they are small and students already own and carry them; the challenge is to deliver educational content and services appropriately on mobile devices.

CHAPTER II

METHODS

For my methods, I used the Support for Academic Computing Model (SAC) to evaluate two case study sites. The SAC is a minimal logic model for academic computing, as described in the previous chapter. My work reports on assessing what academic technologies are both actually in place in the two settings and perceived to be in place, a comparison of findings to the SAC model, the identification of missing technologies described by the SAC model, and assessing whether other essential components should be present in the model. The evaluation I conducted relative to the SAC model attempts to help validate or inform the model through the process of determining the availability and utilization of technology answering the following research questions:

SAC Comparison

- RQ1. How comparable is the educational technology infrastructure of the University of Oregon College of Education (COE) to the Support for Academic Computing Model (SAC)?
- RQ2. How comparable is the educational technology infrastructure of the University of Oregon School of Architecture and Allied Arts (AAA) to the Support for Academic Computing Model (SAC)?

SAC Utilization

- RQ3. What proportion of the available educational technology infrastructures in (1) and (2) above are utilized by faculty in COE and AAA?
- RQ4. What are the problems and gaps involved in the utilization of educational technology services for these two organizations?

I descriptively explored technology use at two case study sites as described below. Both are at the University of Oregon. **My hypothesis is that there will be major differences within colleges due to the different needs but that it will still be possible to draw an effective and useful comparison to the minimal model in both cases. I also hypothesize that I will collect information to better inform and improve the SAC model.**

I used a semi-structured interview protocol (SSIP) which is designed to solicit information by defining the academic computing technologies of the colleges based on, in this case, the perception of faculty. For the SAC logic model three components discussed earlier, the interview protocol explores:

- Overall technology infrastructure,
- Collaboration tools,
- Inhibiting factors in using technology,
- Depth of integration of technology/purpose of use,
- Supports for faculty,

- Hardware and software that allow or impinge upon the utilization of instructional technology
- Perceived availability due to awareness.

My study is a knowledge-oriented program evaluation (Patton, 1997) regarding the agreement and discrepancies of the programs with the SAC model, and the agreement and discrepancies across the samples. The purpose of a knowledge-oriented approach is to emerge knowledge and information that can form a value base for future decision-making regarding programs. It employs a research approach described by Patton (1997) that references how two programs rank or compare to a model, as well as the resources that are available and necessary to operate at an institution (p. 192-194). Hence I am looking at the logic model I have developed and comparing it to what COE and AAA have in addition to doing cross-case comparisons between the two sites. The logic model provides a snapshot of areas of application and desired outcomes.

Stakeholders involved in the evaluation (College Faculty and IT Staff) will enhance the usefulness of the results and process of the utilization oriented evaluation as end-users and supporters. These stakeholders are likely to contribute to decisions about action implications of the evaluation findings, because their use and awareness will yield information (Greene, 2005, p. 397). Improvement in technology implementation can be ultimately advantageous for the institution.

Outcome Measurement

The case considered here is whether and how evaluation mechanisms can help ensure that institutions employ appropriate tools and approaches such that instructional technology services operate at a full capacity for the given resources and needs. The

ultimate goal of formative evaluation is to create a more usable, compatible, and effective product (Weston, 2004, p.62). Academic computing functions perform best when all IT systems are in place and working properly, and when this is verified through appropriate program evaluation in a continuous improvement effort.

I have examined outcomes to see if the existing IT infrastructure within the two College settings is sufficient to meet the academic computing needs, so the focus of the knowledge orientation for the evaluation is perceptions of outcomes. Outcomes measurement involves identifying and measuring at least some outcomes of a program, or a program aspect. It will provide a “learning loop” to help feed information back to institutions on how well they are doing in given areas (Hatry, 1996, p. 4). Outcomes measurement is useful because it helps programs improve services and the findings of the evaluation can be used to adapt programs effectively. The outcomes examined are described by research question RQ1-4.

Active support from the participating program toward the outcome measurement process is vital to its success (Hatry, 1996, p. 13). The level of achievement on specific outcomes will be different for different participants, therefore I need to know under what circumstances the outcomes have occurred (Hatry, 1996, p. 68). This, in turn, can raise questions that may help me recommend the appropriate services to participants with particular characteristics. It is important to be able to link level of achievement on outcomes to participant and program characteristics that may make a difference, and to include a sufficiently representative sample in my data collection efforts.

Program Evaluation Process

The process of planning and implementing an outcome program evaluation with a knowledge-orientation entails six steps that I employed in my methodology: (1) constructing a program logic model, (2) deciding on which programs to investigate, (3) identifying outcomes to measure and outcome indicators, (4) delivering the outcome measurement, (5) developing a timeline, and (6) monitoring data analysis and report preparation (Hatry, 1996, p. 15).

Next, some definitions of terms will be provided, then these six steps will be explored in more detail, in application to my research questions.

Definition of terms. Inputs include resources dedicated to or consumed by the program as well as constraints on it (Hatry, 1996, p. 17). In this evaluation the inputs will be considered as staffing support, centers/programs, and software/hardware.

Activities are what the program does with inputs to fulfill the need and address the mission (Hatry, 1996, p. 17). In this case, activities will be considered to be support services, consultation, trainings, workshops and programs. I considered the various forms of resources available that I can identify in the two contexts through the knowledge-collection stage. This would be different from a fuller depiction of professional development, which is outside of the scope of this research. I took into account such comments as the consultations, trainings and workshops that stem from immediate needs of faculty. Such learning support sessions refer to momentary support needs that are related to instructional and research tasks such as editing educational video or assistance in uploading a grant application.

Outputs in a knowledge-oriented program evaluation approach are the direct products of program activities and measured in terms of some aspect of work accomplished. They are important because they are intended to lead to a desired benefit, and may change in the context of such factors as the target population, program efficacy and over time. (Hatry, 1996, p. 17). “Outcomes are benefits or changes for individuals or populations during or after participating in program activities” (Hatry, 1996, p. 18). The outcomes I investigated were faculty responses to the existing support infrastructure, through the steps of my evaluation process discussed.

Informing is the process of sharing the results of the research questions with stakeholder communities. My primary audience for the dissertation itself is the field of academic support for information technology in higher education settings, which may be able to gain from more models and approaches to evaluation. I also will share my findings with the UO IT Community and College leadership in each of the two case study sites.

Limitations and Potential Problems of Outcome Measurement

Although outcome findings may show that program participants are not experiencing the intended benefits, they do not necessarily show where the problem lies or what is needed to fix it. Additionally, there can be substantial limitations in data sources about outcomes. Figure 7 shows some of the potential advantages and disadvantages for data sources that may be available in the two-site case study settings.

Advantages	Disadvantages
Departmental Records	
Available, Accessible, I know how the data was collected	Value of the data depends on how carefully it was recorded, existing records seldom contain all data needed
Other Campus IT records	
Offers a perspective on participants' experiences different from mine	Value of the data depends on how carefully it was recorded, existing records seldom contain all data needed, confidentiality and other issues may make data unavailable to me, their time frames may not match mine, Identification of participants may pose a problem
Specific Individuals	
Can provide first-hand view of participants' experiences and outcomes during and after program involvement	Information can be biased by memory, interpretation, perceived pressure, fears

Figure 7. Portions of Advantages and Disadvantages for Data Sources for Outcomes Indicators - Exhibit 4-A (Hatry, 1996, p. 86).

Additionally, the findings of outcome measurement do not themselves entail or fully reveal whether the outcomes being measured are the right ones for a particular program. Assuring that the process is measuring the appropriate outcomes is up to those who design the evaluation process (Hatry, 1996, p. 22), and evidence should be put forward, such as described in my literature review and supported of the logic model and its attributes in Chapter I.

Steps in the Knowledge-Oriented Program Evaluation Process

Step 1. Step 1 in this evaluation has already been described. It consists of constructing an initial program logic model, see Chapter I.

Step 2. Step 2 consisted of deciding on which programs to investigate. The two case study sites selected here are the University of Oregon College of Education (COE) and the School of Architecture and Allied Arts (AAA). The two sites were purposively selected to represent two different but related contexts (Miles & Huberman, 1994). The College of Education and the School of Architecture and Allied Arts are two moderate sized academic units on the University of Oregon campus, although note that due to the specific missions and structures of the organizations, scale and scope vary considerably, as described in Chapter III. On another measure the two colleges are different based on the mission aspect that involves technology utilization. At UO, AAA focuses extensively on visual representation and design, whereas much of the COE is based on data-driven decision-making, employing assessment outcomes and focusing on analytic methods. Additionally, AAA has innovative studio-based education where students collaborate in creative communities. COE has a diverse research culture, extensive teaching and learning situations, and extensive outreach goals and interventions. I investigated the comparisons and contrasts of technology for the research questions between these two settings.

Step 3. Step 3 in my knowledge-oriented program evaluation approach required I work closely with the case study contexts to identify outcomes to measure and outcome indicators. During this step, I reviewed the following materials: documents that describe each department's mission within the two case study contexts, recent program reports,

descriptions of and reports from outcomes measuring initiatives or assessment efforts from other comparable colleges at the UO, and any relevant resource materials from the university.

Review of departmental materials suggested what the program's results for participant intended to be and those of similar services. Examples included the most recent annual report of program activities, organizational mission statements, annual faculty and staff reports that may be available, statements of purpose in funding applications and finding from past assessments (Hatry, 1996, p. 33).

In selecting my outcomes I considered whether the measurement of the outcome will help identify program success and help pinpoint and address shortcomings. I also considered how and whether the faculty and staff stakeholders of the case study sites will accept the program success indicators identified as valid outcomes. (Hatry, 1996, p.55). The outcome indicators identified were used to prepare a semi-structured interview protocol for data collection. I went to the end-users to see what types of technologies are utilized. The questions shed some light on matching to the proposed logic model, but not necessarily intended to imply causality across or within the two contexts.

Researchers describe that the semi-structured interview protocol (SSIP) is designed to match questions to informants, reduce redundancy and maximize comprehensiveness of the interview process (Gugiu, P. C & Rodríguez-Campos, L., 2007, p. 339-340.) The SSIP approach has several advantages because it includes questions that evaluators should ask all the key interview informants, resulting in helping to inform the logic model, but also allows for extension probes to be asked to follow-up on the structured questions as important new information arises in a particular interview.

The semi-structured interview protocol, or SSIP, incorporates questions designed to determine the importance of each outcome as judged by key program staff and to determine the hypothetical theory that underlies the logic model elements. However, programs are usually dynamic. As Gugiu & Rodríguez-Campos (2007) state, logic model construction is an ongoing task that focuses on “intended processes and outcomes” (p. 343).

After the interview protocol was drafted, I engaged in a process of reviewing it with experts and using it on a limited basis to uncover any problems (Hatry, 1996). After the protocol was complete I requested feedback on all aspects of the data collection, such as the wording of questions, the content of the questions and the length of time required to complete the data collection (Hatry, 1996, p. 103). I paneled questions prior to using the instrument for peer review. For internal validity, I had other technical staff evaluate in advance if the model fits the academic computing trend they see will serve as useful. Following this I revised the instruments and the data collection procedures as appropriate. If the revisions to the instrument were substantial, I re-evaluated to be sure the problems have been addressed without adding new ones.

Step 4. For step 4, I planned to complete the delivery of the outcome measurement through in-depth interviewing of sampled stakeholders, using the semi-structured interview protocol described in step 3. For the sampling of interview participants, the faculty and staff whom I interviewed are important stakeholders of interest in this evaluation process because they will contribute to important decisions regarding the outcome. Therefore I interviewed nine faculty members from each case study site for at least an hour.

Regarding sampling of the interview participants, I derived a purposive framework working with the case study sites. The overarching dimension I proposed to sample for faculty interview is an *adopter* dimension, from primarily early adopters who tend to exhibit maximum utilization of technology and are likely to know most about the resources actually available to them at their sites to a small group or late or delayed adopters who may not be using much of the available technology or technology support in the context and will be able to comment on some of their perceived barriers to use within the site. With an *adopter* dimension, using the information I received from the interviews as Patton states (1994), I was better able to determine what is available and utilized appropriately at the sites in order to make proper suggestions regarding aspects of the logic model.

For the sampling, I intended to split the evaluation between the two groups of more technologically savvy users versus non-technological, for the approximately nine faculty members at each site. I selected seven faculty members in the “early” adopt category, to help reveal what the most technologically knowledgeable faculty members have been able to identify or use for academic computing at their sites. I included at least one member from each of at least four departments or programs within the case study site, to provide some degree of representation across the site. I also interviewed two faculty members identified in more of the “late” or “delayed” adoption usage pattern, to help reveal more of the perceived barriers or obstacles to adoption. Faculty usage patterns were drawn first from information provided by the IT staff at the sites, a snowball sampling design were used (see below), and the results of the sampling will were checked against the data derived from the interviews to help validate the user’s usage patterns.

As described, I first identified those who may self-identify or be perceived as participating in these two usage profiles regarding technology, by inquiring of College and departmental technical staff regarding those faculty members with whom they have experience. Subsequent inquiry with those identified will then employ a snowball sampling approach (Miles & Huberman, 1994) resulting in the suggestions of others. I worked with my advisor and the case study sites to finalize the selection of the interview subjects based on the snowball sampling data collected, and the availability of interview subjects.

Once the sample is selected, I used the semi-structured interview protocol described previously to ask all respondents the same series of pre-established questions, and followed-up individually with additional probes or questions if the respondent's answer prompts further questions. With my respondents' permission, I used a digital voice recording device to capture the interview, and transcribed all of the interviews.

While conducting this process I may have overlooked other important factors or fail to consider unintended side effects. Therefore, my protocol must retain enough flexibility to search for other potentially important outcomes. I wrote some open-ended interview questions to help ensure that information is not missed that would potentially add to the logic model and its interpretation.

In all data collection efforts, procedures need to protect the confidentiality of participating information. Protecting confidentiality means those involved in outcome measurement refrain from discussing situations, locations, affiliations, and all other information about participants with anyone other than other authorized persons (Hatry,

1996, p. 98). I obtained UO IRB Human Subjects permissions and followed the established process.

Step 5. I developed the timeline for step 5 by coordinating with the stakeholder availability to generate the interview schedule. It was completed for the AAA faculty sample in Spring of 2013, and for the COE faculty in Summer of 2013.

Step 6. For step 6 I monitored data analysis and reported preparations (Hatry, 1996, p. 15), I used data reduction methods with the interview field notes and transcripts, displayed in Figures 9 and 10, to analyze the elements that will serve as comparison indicators. Feedback from interviews resulted in further development of the program logic model and other outcomes that were important to measure (Hatry, 1996, p. 56).

As displayed in Figure 6, I designed my analysis based on the green (technologies) nodes, and code for the red (examples) sub nodes. For each college, I added a different color to display while coding the matching areas along with supplemental tools (examples). As Miles & Huberman (1994) remark on coding functionality, I will use a derivation of the state network data display for my analysis (pp.115, 158). The green nodes would be similar to events, and red sub nodes would be the states as presented in the Figure 8, in display rather than concept.

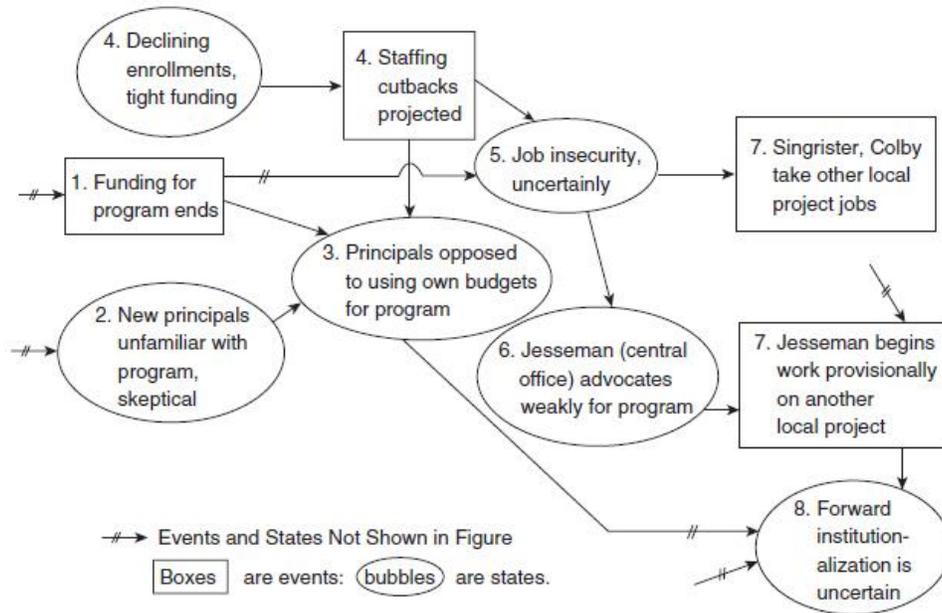


Figure 8. Excerpt from an Event-State Network (Miles & Huberman's, 1994, p.158)

Figure 9 demonstrates the three-way comparison I will conduct to determine how the case study sites, based on the interview data, address availability and utilization of technology. I did thematic coding with the data displays as Patton indicates. The coding entailed matching the SAC model with results from the COE and AAA interviews. I assigned different color schemes to the colleges, blue for COE and red for AAA, and added the findings to my model resulting in a data-driven view of the model. Patton describes how effective program evaluation looks for unique institutional characteristics:

Between programs, inductive inquiry involves looking for unique institutional characteristics that make each setting a case unto itself. At either level, patterns across cases emerge from thematic content analysis, but the initial focus is on full understanding of individual case, before those unique cases are combined. (Patton, 1997, p.279)

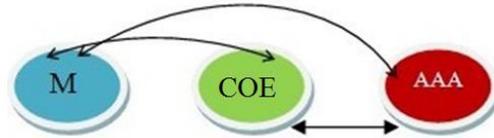


Figure 9. Diagram of 3 way comparison among the following: (i) a minimal logic model (M), which in the form here of the SAC model is anticipated as a necessary baseline for Academic Computing, (ii) College of Education (COE) infrastructure, and (iii) the School of Architecture and Allied Arts (AAA) infrastructure.

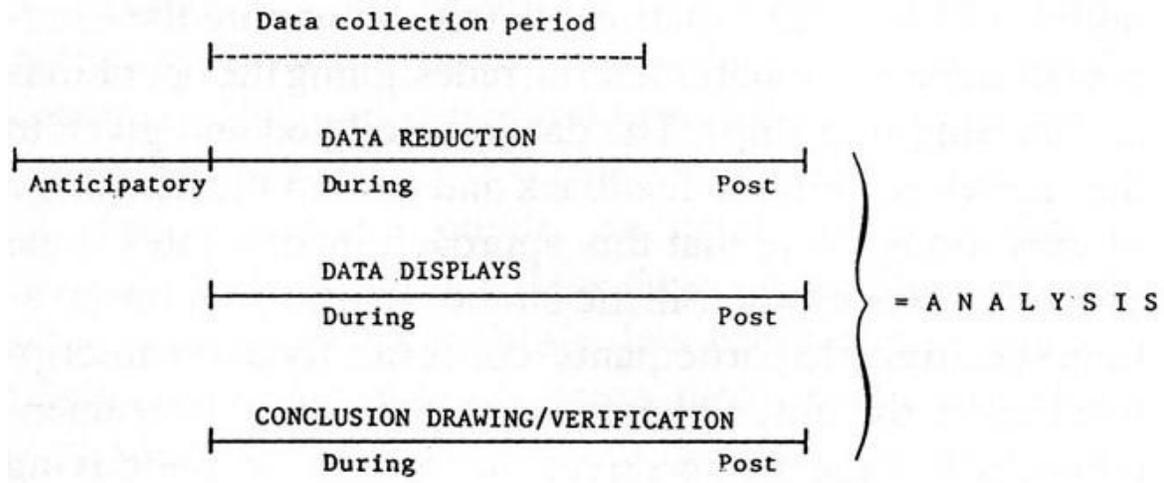


Figure 10. Components of Data Analysis: Flow Model

I used data reduction methods to match the two cases against the academic computing model. Miles and Huberman (1994) visually display the flow of how qualitative data is analyzed in Figure 10 (p.10). Data reduction refers to the process of selecting, focusing, abstracting, and transforming the data. As data collection proceeds, further data reduction occurs, such as writing summaries, coding and finding themes. The data reduction/transforming process continues until the final report is completed. Hence, I matched the information I needed which fit with the patterns I found and reduced the information in order to form some conclusions. Figure 10 displays a linear process for how this analysis works but the Figure 11 shows how all of the steps work together in verifying findings.

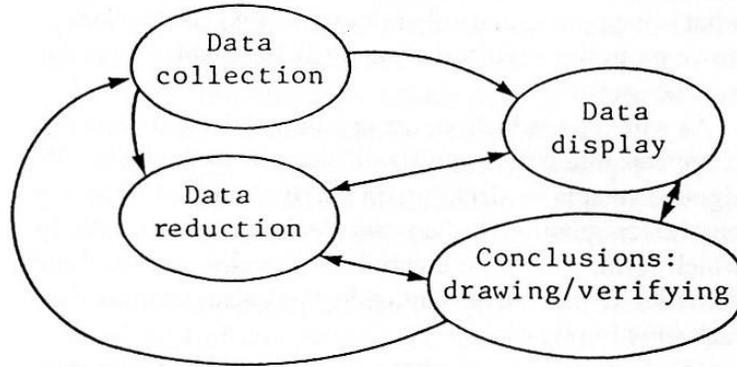


Figure 11. Components of Data Analysis: Interactive Model (Miles & Huberman's, 1994, p.12)

My analysis used similar methods as Miles & Huberman's (1994) displayed in Figure 11. Via the coding of data, data reduction occurs leading to the data display. Entering the data requires further data reduction. As data reduction takes place through the analysis I drew preliminary conclusions, which lead to an evidence case for revising and/or validating the logic model. From the start of data collection, I began to filter information noting themes, explanations and suggestions.

According to Miles & Huberman's (1994) verification may be as brief as checking thoughts against my notes while writing, or it may require a review with my advisor and others to develop "inter-subjective consensus" (p. 12). These steps needed to occur for the significance of the data to be tested out for plausibility that ultimately leads to building a validity case for a new logic model from Figure 6. The data reduction displays also helped to display the information in a way useful to users:

When you present outcome data, include information that tells users that probable reasons why the outcomes look usually high or low (Hatry, 1996, p.118).

I employed the cross-case analysis at the two sites to enhance some aspects of generalizability, although of course the limitations remained of only two site cases at a

single university. A fundamental reason for cross-case analysis is to deepen understanding and explanation across more than one situation (Miles & Huberman, 1994, p.173). A strong motivation for using this approach is to strengthen my SAC model through examining the similarities and differences across the cases determined how conditions may be related.

Based on a case-oriented analysis in a data display I reached across contexts (Miles & Huberman, 1994, p. 173). As Miles & Huberman state (1994) I used the case-oriented approach because it considers a case as a whole entity, looking at configurations, associate, causes and effects within the case and then turning to comparative analysis of another case (p. 174). I also considered the variables identified in my themes and patterns, and their relationships to the case. This integrates case-oriented and variable-oriented approaches as Miles & Huberman (1994) discuss (p. 176).

Helping to address the research questions will be approaching the problems through multiple exemplars via interpretive synthesis. After deconstructing prior concepts of a particular phenomenon I collected multiple examples and inspected them carefully for essential elements or components (Miles & Huberman, 1994, p. 174).

I used several tactics to determine similarity of pattern, such as Miles and Huberman describe in counting the number of identical predictors or similar sequences, and matching outcome themes from a stream of predictors then comparing them (Miles & Huberman, 1994, p.232). I used concept maps to display what was available in the colleges and showed how it visually overlaps in shared technologies.

CHAPTER III

RESULTS

This chapter presents the results of this study, organized by Steps 1-6 described in the previous methods section. These six steps are: (1) constructing a program logic model, (2) deciding on which programs to investigate, (3) identifying outcomes to measure and outcome indicators, (4) delivering the outcome measurement, (5) developing a timeline and (6) monitoring data analysis and report preparation (Hatry, 1996, p. 15).

Steps 1, 2 & 5 in this analysis have already been described and conducted in Chapter II.

Step 3: Review of Materials and Development of Interview Protocols

Step 3 involved further identifying outcomes and outcome indicators so that the interview protocol could be further drafted and refined, and so that the interview sample group could be appropriately recruited along the adopter dimension described in Chapter II.

Review of materials for understanding the academic technology support infrastructure at the two sites began with reviewing web site documents, and then engaging in conversations with the IT directors at the two sites. Table 1 lists a classification of the college's demographics.

The web site has become a common and essential tool to communicate resources and services and is a natural starting point for gathering information about each site (school), including policy documents about program and missions as well as in some cases technology policies and plans. The next paragraphs share the mission statements of the colleges as stated on their web site, to better understand similarities and differences between the two contexts.

AAA. AAA is the principal center in Oregon for the study of architecture, art, community and regional planning, and design. The school offers undergraduate and graduate accredited degrees in Eugene and Portland. The ten academic departments and programs include architecture, art, arts and administration, digital arts, history of art and architecture, historic preservation, interior architecture, landscape architecture, planning, public policy and management and product design.

AAA describes itself as dedicated to advancing the understanding, value, and quality of visual culture and the built, natural, and social environments through excellent and distinctive teaching, research, and creative endeavors. Grounded in a unique multi-disciplinary structure, AAA describes itself as a diverse, collegial learning community of students, faculty and staff members. The school describes how it seeks to enhance the lives of individuals and communities through endeavors that stem from intellectual curiosity, critical thinking, and broad inquiry, rooted in the inter-relatedness of theory, history, and practice. AAA specifies a mission dedicated to the principles of civic responsibility, environmental sustainability, international understanding, and cross-disciplinary education. References to technology are not specifically made in the AAA mission statement and no explicit technology plan is available for AAA, although implicitly a role for technology can be seen in many of the elements mentioned.

Policy and scope of service. AAA Computing Services provides technology services to their students, faculty, and staff. According to the IT director of AAA, technology support for the college is accomplished with four full time staff, four to six student Help Desk employees, and eight to ten Output Room student employees (Sullivan, 2013a). Full time staff consists of one director, an Output Room manager, a

lab manager/system administrator, an educational technology consultant, and an IT consultant. According to AAA administrators, the service base consists of roughly 85 tenure-related faculty, 60 adjunct faculty, 35 staff and officers of administration, and 1700 students including both undergraduate and graduate students (Sullivan, 2013b). AAA Computing Services also supports about 30 customers in grant-funded institutes and 15 customers in the University Campus Planning and Real Estate office.

AAA Computing Services reports supporting approximately 550 university-owned computers, 100 university-owned printers, as well as equipment owned by individual students, faculty, and staff (Sullivan, 2013b). AAA has three support labs. Support provided by the program consists of administering computer labs, a computer replacement plan, course folders, email, equipment checkout, file sharing, Help Desk, networking connectivity, software licensing and video conferencing. Their educational technologies assist AAA educators with facilitating e-learning principles in their pedagogical pursuits via digital media, internet applications, mobile devices, and traditional computing technologies (Sullivan, 2013b).

COE. COE is the college of education at the University of Oregon. It prepares students in the study of educational foundations, curriculum and teaching; special education and clinical services; counseling psychology and human services; educational leadership and policy; global education; and research methodologies to serve education and the social sciences. The school offers undergraduate and graduate accredited degrees available through various locations in the state. The 18 academic departments and programs include many of the areas listed above.

The materials gathered about COE presented COE as a network of inclusive learning communities. Undergraduate, graduate students, and continuing professionals study with nationally recognized faculty to become teachers, administrators, clinicians, social service professionals and educational research scientists, as well as taking on numerous other positions. Faculty and students also work together with school districts and agency partners to meet the needs of children and families nationwide. These partnerships give their students access to the diverse array of best practices in education and human services, from a range of academic programs, from the research of nationally renowned faculty, and from practicing professional partners in the field. In addition to their academic programs, the UO College of Education includes an alliance of nationally prominent centers, institutes, and affiliated research and outreach units working to fulfill their mission of “Making Educational and Social Systems Work for All” (Woodbury, 2013b).

Policy and scope of service. Information provided from communications with the COE IT Director regarding College technology support staff was sparse. COE appears to be less centrally organized in the academic technology support services and to have less data centrally available. The information gathered indicated approximately eight full-time technical staff or full-time equivalents offer support to the academic mission college wide. The College of Education Information and Instructional Technology group supports a wide range of academic and administrative needs by providing the following resources and services: facility of the HEDCO Learning Commons, file sharing/storage for COE faculty & staff, computer set-up & configuration, content capture for COE faculty & staff, Digital Asset Management for Web-centric content, networked printer

set-up & configuration, IT consulting & recommendations, laptop back-up solutions, consulting on data management, storage, and encryption, coordination and brokering of campus-wide IT services. (Woodbury, 2013c)

However, for COE there is a mixed picture of technology support across the college. Some services are offered centrally in the college; others are only available within specific programs or departments. Furthermore there appear to be few clear lines establishing the breakdown of services available, or notifying faculty about what is available to all faculty in the College, at the College level. COE IT support staff report there can be delays in services provided and limited outreach to faculty.

Table 1.

Summary Table of Data from College/School

Factors	AAA	COE
Reported Tenured Faculty	55	28
Reported Additional Tenure Track Faculty	32	11
Reported Non-Tenure Track Faculty	92	235
Reported Technology Support Staff	5	4
Reported Support Labs	4	2
Academic Departments & Programs (as listed on College/School website)	10	18

Note: Information from departmental websites and emails: Woodburn 2013, 2104); Sullivan 2013); Sharp 2014; & University of Oregon Fall 2013 Employee Counts by Type, Venegas-Rogers, 2014.

University Level Services. Note that in addition to the technology support offered at the college and school level for these two sites, there are also centrally available services into which both groups can utilize. These include; user accounts, antivirus, scheduling, centralized calendaring, email, computing labs, learning management system, video conferencing, streaming media, web publishing, site licensed software, printing,

scantron services, and potentially high performance computing if the faculty members have a need for this. Note that these services should not be specifically different between the two contexts, as faculty members in both units should have similar access. However, these centralized services are part of how a base model such as the SAC model for academic computing is met at a particular institution. So the services listed above are likely to be part of what may emerge in the interviews, and what faculty will describe in terms of resources available to them to meet a minimal model such as SAC. Also, a differential *understanding* or *awareness* of the services that may emerge between the two study sites, which if found will also be important to note in the discussion.

Designing the interview protocol. Using the SAC model along with the information gathered about the two study sites, an interview protocol for the data collection to commence in Step 4 was designed. I utilized a semi-structured interview protocol (SSIP) as discussed in Chapter II. In addition to inquiring about usage around the SAC model shown in Figure 6 the questions that were asked were the following:

- As inputs, to what types of staffing support, centers/programs, and software/hardware do you have access?
- As activities, what consultations, trainings, workshops and programs are available?
- Have you used any collaboration tools in your instruction?
- What are some inhibiting factors in using technology?
- Do you use a CMS/LMS and which one?
- What instructional media tools do you use?
- What productivity/content creation and research tools do you use?

I shared these questions in writing with the interview respondents. Respondents also received Figure 1 and Figure 6 combined for reference throughout the interview, to have in hand for any discussion points. An approved consent form was also provided, which contained the research questions of the study.

Step 4: Interviews

Interviews were completed with 18 faculty members, nine from each of the two study sites.

AAA. Correspondence with the AAA IT Director offered a list of faculty members at the site ranging from being early adopters of educational technology to those with less experience and background for technology use in their academic work. Nine faculty members in AAA were purposively selected to represent the *adoption* range discussed in Chapter II and were contacted via email for interview requests. There was a positive response with most of the faculty members agreeing to participate. For those who were not able to participate, subsequently more names were identified and interviews solicited, until nine faculty members were successfully recruited for the AAA interview process.

The nine faculty from AAA represented the following programs: Product Design (PD), Arts and Administration (AAD), Architecture (ARCH), Art History (ARH), Landscape Architecture (LA) and Planning Public Policy and Management (PPPM). All interviews were in-person and with the materials provided previously described. Interviews once again began with a person introduction as described in the interview protocol, and requesting permission to record the interview.

For all of the interviews, I recorded interview notes by hand during the interview in addition to employing a digital voice recorder. Upon conclusion the interviews were transcribed. The in-person interviews lasted between 30 minutes and 90 minutes, with the variation due primarily to the length of discourse in which the faculty members engaged for the structured questions as well as in some cases a differential number of follow-up probes depending on what the interviewee described in the structured questions.

Table 2 shows seven respondents at each site in the “early” adoption pattern, selected as described in Chapter II to help identify the range of services that faculty might feasibly find at their site who are searching for the support, while two respondents in the “late” adoption pattern help add information on the obstacles, barriers and knowledge of those who may be in a less active state for seeking the academic technologies and their uses.

AAA subjects are coded AAA1 to AAA9 in Table 3, and associated with their responses coded by SAC Model component in the columns of Table 3.

COE. Once again, data were collected for the second study site based on interviewing nine faculty members. They held appointments in the following programs: Education Studies (EDST), Counseling Psychology and Human Services (CPHS), Educational Methodology, Policy, and Leadership (EMPL), Special Education and Clinical Sciences (SPECS). Correspondence with the IT Director offered a list of faculty ranging from early adopters of educational technology to those with less experience or implementation. Faculty members were contacted via email for interview requests. Once again most of the faculty members agreed to participate, and subsequently more names were identified to complete the set of interviews. All but one of the interviews was

conducted in-person. The other interview due to timing was conducted over the phone in the same manner as the others. The professor was emailed a copy of SAC Model and instrument receiving their permission with a signed and attached consent form. Interviews once again began with a person introduction as described in the interview protocol, and requesting permission to record the interview.

COE subjects are coded COE1 to COE9 in Table 7. The SAC Model and instrument were presenting during the interview, and interview responses coded by SAC Model component in the columns of Table 3. The interviews once again lasted between 30 minutes to 90 minutes.

Step 6: Report Results

AAA. Upon transcribing the interviews, themes emerged and comparisons were made to the SAC model. For AAA, the results are displayed in Figure 12a and Tables 2-6 below, similar to Miles and Huberman (1994) characteristics of field study sample table (p. 32).

Figure 12a plots subject responses against the SAC model, with the subject code listed where SAC model components have been implemented or applied in the faculty member's use of academic technology.

Table 2 displays the faculty classification based on the early and late adopt dimension. As designed in the study, there were more participants who are early adopters or technologically savvy based on identification and usage. The faculty members who were identified as late adopters or more delayed in their academic technology adoption also provided valuable information especially about the navigation of the resources for

more general use across the entire population, as compared to the more specialized knowledge of the early adopter pattern.

Table 3 summarizes in tabular form the subjects in rows against the SAC model components in columns, with a ‘yes’ recorded where the SAC model components have been implemented or applied in the faculty member’s use of academic technology, and a ‘no’ recorded where this was not the case for the subject.

Tables 4-6 explore the subject responses to the SAC model variables in more detail, showing specific instances of use or comments by the subject about the application of the SAC model component to their academic technology uses.

Table 2.

Faculty Summary Table of Responses per Adoption Classification

Categories	AAA	Total	COE	Total
Early adopters (technologically Saavy users)	2,3,4,5,6,8,9	7	3,4,5,6,7,8,9	7
Late adopters (more typical users)	1,7	2	1,2	2

AAA SAC Model. Overall for AAA, Data Visualization, Faculty-Provided Learning Objects, LMS/CMS and Video & Audio were the SAC model components employed most frequently by the faculty members interviewed. Augmented Reality and Educational Gaming were utilized least by the AAA subjects. Lecture Capture and Distance Learning/Collaboration in the form of Web Conferencing were described by subjects as basic academic technologies necessary to their work, so I added them to the model, as displayed in Figure 12a and the Table 3 on the following page. Having these

components enhances the SAC model given the increasing amount of utilization. More and more instructors, learners and researchers are using remote technologies to connect to knowledge and share information due to the ever so changing educational landscape.

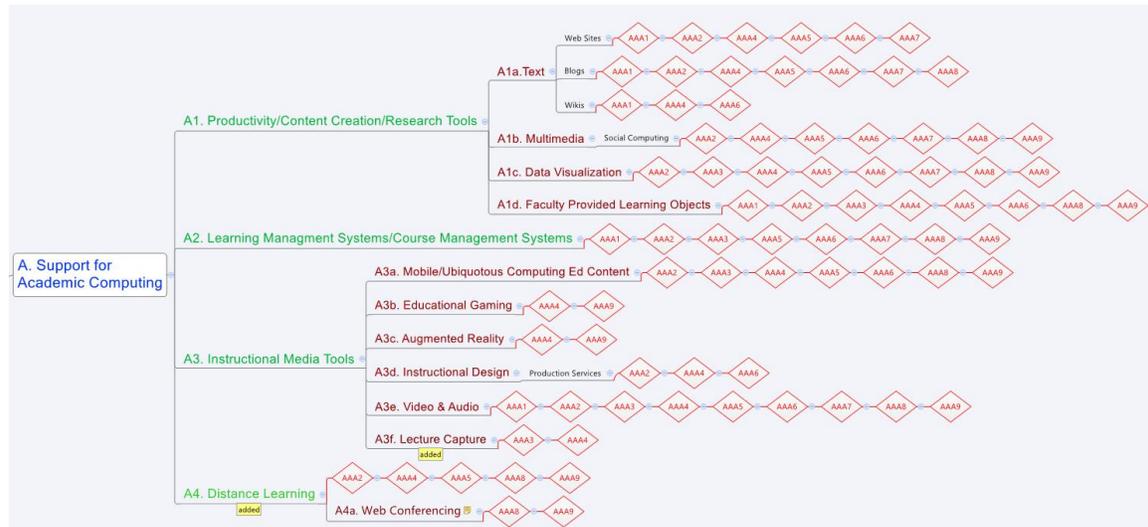


Figure 12a. AAA SAC Model results.

Table 3 displays the number of early adopters and late adopters in AAA with regards to using the academic computing model components. Early adopters overall use more of the technologies in various applications. They are either ahead of the curve incorporating cutting edge approaches that engage their students and enhance their course content or are tech savvy enough to explore emerging tools. The late adopters report that they don't catch onto the need for or usage of some of the more advanced technologies, don't have the time to investigate them, or only use the basic functionality of the available tools. In some respects the late adopters feel that their existing curriculum is sufficient as is and utilizing technology will not add value to the instruction. One late adopter interviewed is not aware of the existing tools that can be employed into their research or instruction, and that administration will not support their efforts. For early adopters in this setting, the faculty seem more eager to try new technologies which assist

their research and find ways to help students learn concepts better that may translate into success.

Table 3.

Summary Table of Results that Emerged from AAA Interviews. AAA subjects are listed in rows and grouped in adoption classification based on their usage of the SAC model components listed in columns. The late or more delayed adopters show in the first two rows; the early adopters show in the remaining rows. Numbers at the end of the rows and columns represent the N (percentage), meaning the number of subjects responding in the affirmative and the percentage of the total, per each row and column of the table.

Faculty SAC MODEL VARIABLES

	A1a. Text	A1b. Multi	A1c. DataV.	A1d. L.O.	A2. LMS	A3a. Ubiq	A3b. Game	A3c. AugR.	A3d. Inst.D	A3e. Video	A3f. Lec.C	A4. D.L.	A4a. WebC.	Total (%)
AAA1	Yes	No	No	Yes	Yes	No	No	No	No	Yes	No	No	No	4 (31%)
AAA7	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	5 (38%)
AAA2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	9 (69%)
AAA3	No	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No	No	5 (38%)
AAA4	Yes	Yes	Yes	Yes	No	Yes	No	11 (85%)						
AAA5	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	8 (62%)
AAA6	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	8 (62%)
AAA8	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	9 (69%)
AAA9	No	Yes	No	Yes	No	Yes	Yes	10 (77%)						
Total(%)	7 (78%)	7 (78%)	8 (89%)	8 (89%)	8 (89%)	6 (67%)	2 (22%)	2 (22%)	4 (44%)	8 (89%)	2 (22%)	5 (56%)	2 (22%)	

Trends across the “Adopter” categories for the small sample of interviews should not be over interpreted. However, in these cases, they that reveal that for the AAA site, early

adopters show a quite different overall pattern at 66% usage of at least some tools in each category as compared to 34.5% for the late adopters. The intensity of use may be different for earlier and later adopters as reported by the IT staff with whom they work and from some of the specific comments that can be seen in the sections below, also the overall pattern in the presence or absence of use for the basic elements of the SAC model is different, for at least this small selection of cases.

Productivity/Content Creation/Research Tools. Most faculty members in the AAA sample have websites for their research and/or their courses in addition to blogs and wikis as shown in Table 4. Out of the text-based tools, websites are utilized the most, then blogs and lastly wikis for AAA faculty.

In terms of social media, Facebook is employed for recruitment purposes of students who are potentially interested in the program and for communicating program details and announcements. The most prevalent social media tools used in teaching and learning more directly are the social bookmarking tools on the web that organize content for sharing and tagging. Data visualization is directed toward displaying charts, diagrams, word clouds, designs, graphics, and maps. Faculty-Provided Learning objects in AAA account for the tutorials for demonstrating design techniques along the lines of shapes and mapping programs.

Table 4.

Summary Table of AAA Uses of Productivity/Content Creation/Research Tools

Faculty	SAC MODEL VARIABLES				
	Total	A1a. Text	A1b. Multimedia	A1c. DataV.	A1d. L.O.
AAA1	3	Website same as blogs site, wiki	No	No	Yes
AAA7	3	Website, blog	Twitter	Static charts	No
AAA2	4	Websites as teaching portfolio for courses	Social bookmarking as assignment	Through presentations and image editing	Tutorials
AAA3	2	No	No	Design software	Studio Concept
AAA4	4	Website, blog	Social bookmarking	Word clouds, mapping	Mashups
AAA5	4	Blog, website	Facebook	Powerpoint, diagrams	3D-form
AAA6	4	All of the above	Social bookmarking	Graphics, diagrams	Shapes
AAA8	4	Blog	Facebook	Word clouds	Mapping
AAA9	2	No	Data sharing	3D modeling, mapping	GIS
Total	7		7	8	8
Average(%)	7.5 (83%)				

Learning Management Systems/Course Management Systems. All faculty use an LMS in one shape or form to disseminate course materials, sharing the syllabus, readings, posting articles and links to external websites as resources. The University of Oregon has licensed Blackboard and many faculty are satisfied with the CMS or they use it because students expect it. Power users of technology find Blackboard awkward in numerous ways, as described in the personal accounts are presented in Table 5. Some respondents

mention the collaborative features that are integrated into the grade center are very convenient to use as are the assessment components.

Table 5.

Table of AAA Uses of Learning Management Systems/Course Management Systems

Faculty	LMS/CMS USE
AAA1	Blackboard heavy user, not willingly. And reluctantly using it, features clumsy, blog tool painful to read, discussion boards not user friendly. Have students upload audio files using the assignment feature, concerned about it crashing, but has clean grading.
AAA2	Used yes and no, used as one big tool box, but not as traditional course site management system, primarily use the grade book to store grades, occasionally use email function extensively use for contact info (emails). Use different tools to convert to other formats. Use Google docs to edit spreadsheet, use WordPress for classes not Bb, only for advanced digital class to store documents and post syllabus, only because he hasn't gotten around to building another site, as an ad hoc/turnkey solution.
AAA3	Upload digital files to Blackboard, give video links, tutorials of YouTube, a home base for course content, setup folders, use for file uploads and tracking assignments. Set up individual access and get timestamps and upload management, submit assignments to have contained within LMS because it's easier to manage. An analog process is turned into digital.
AAA4	Not used for 4 years, AAA partly for longitudinal blog site = porous, fulfill vision for teaching not bound by terms, use Blackboard only to email (convenient).
AAA5	Yes use Blackboard for announcements, assignments, posting, use for grades of course content, schedule, very one way. Not for tests, quizzes, discussion, only visual, they have to share products, and have a live discussion with product in front of them.
AAA6	Used since 1999. It's great for distant learning but not for studio class. If you are in art why use Bb if you can't customize it.
AAA7	Yes use Blackboard for student's to blog in groups and comment on each other's posts. Have minimal usage, everything is posted in course documents, use grading feature somewhat, and send emails, but no announcements.
AAA8	Use Blackboard to mostly post readings on, use assignment tool, grade center and for student viewing, blog didn't work as discussion board, reading reactions, assignments are large file size because of graphical content so use AAA space.
AAA9	Blogs used on Blackboard for all courses, discussion boards, email, and some digital files available for students to download and manipulate, used for convenient storage and organizational device, rather than other features, because investment in time in managing those resources is high and time constraint.

Instructional Media Tools. There are different forms of the Mobile/Ubiquitous Computing Educational Content utilized across the board with AAA faculty as displayed in Table 6. Very few instructors in AAA use the institutionally supported iClicker, a specific personal response system. Many choose to utilize devices that permeate education and day to day life, hence smart phones.

Educational gaming has not received much traction yet in AAA due to lack of models available to be incorporated, or possibly to limited utility in the field. The same is true at this point of Augmented Reality: limited use, few examples on which to model use, and limited ideas of how AR could be useful for teaching and learning in the field. Also, both formats of gaming and AR may still require too much initial investment for it to be practical for individual faculty members to employ at this point.

Based on the provided comments, Instructional Design Production Services are not well advertised to faculty, nor are they believed to be scalable due to perceived specialized needs along with lack of development support. Video and Audio is extremely applicable in AAA instruction and is used to share tutorials on software, simulations, and existing examples embedded from YouTube and other video sharing sites. Lecture Capture was addressed by several respondents and is becoming a trend under Instructional Media. Faculty record their lectures and share them to accommodate for students at a distance, those needing special accommodations, to address attendance issues, or for future reviewing.

Table 6.

Summary Table of AAA Uses of Instructional Media Tools

Faculty	SAC MODEL VARIABLES						
	Total	A3a. Ubiq	A3b. Game	A3c. AugR.	A3d. Inst.D	A3e. Video	A3f. Lec.C
AAA1	1	No	No	No	No	Still and moving images with audio	No
AAA7	1	interested	No	No	No	YouTube, TED talks	No
AAA2	3	Smart devices, No no tools with linear nature	No	No	production service for movie game	streaming server embed YouTube videos	No
AAA3	3	research smart	No	No	No	software tutorial design interfaces	accommodations
AAA4	6	content Delivery	only research	only research	low threshold	Prezi	distance ed
AAA5	3	Pollevery-where	No	interest	No	tutorials	No
AAA6	3	mobile tools	No	No	gallery	tutorials	No
AAA8	2	polling	No	No	No	Vimeo, YouTube	No
AAA9	4	pictures GIS	Software	No	No	Simulations	No
Total	7	7	2	2	3	9	2
Average(%)	4.2 (46%)						

Distance Learning. Distance learning is a component that was added to the SAC Model based on increased utilization. It was not part of the original model (considered outside the scope of the dissertation as described in Chapter II) but a sufficient degree of common usage from the interview data warrants it at least being referenced as included in the model. Many faculty have two groups connecting remotely as a type of web

conferencing. Faculty use Skype predominantly for professional development. Distance learning due to the changing landscape of learning and increased accessibility is taking rise as shown below in Table 7. Some faculty teach in various physical locations such as from the Portland White Stag building or from the Eugene campus, and the academic technology support affordances allow for better flow of knowledge to reach more students. While full details of this discussion will remain outside of the scope of this dissertation, the data findings reinforcing this need are noted here as an implication for future work. Some programs in AAA have a satellite campus where remote students gather to learn from an instructor on the main campus.

Table 7.

Summary Table of AAA Uses of Distance Learning

Faculty	SAC MODEL VARIABLES		
	Total	A4 DistanceL.	A4a. Web Conferencing
AAA1	0	No	No
AAA7	0	No	No
AAA2	1	Yes	No
AAA3	0	No	No
AAA4	1	Yes	No
AAA5	1	Yes	No
AAA6	0	No	No
AAA8	2	International	Adobe Connect, Skype
AAA9	2	OSU	SmartBoard, Skype
Total		5	2
Average(%)	3.5 (39%)		

COE. For COE, the results are displayed in Figure 12B and Tables 8-12 below, similar to Miles and Huberman (1994) characteristics of field study sample table (p. 32). Figure 12B plots subject responses against the SAC model, with the subject code listed

where SAC model components have been implemented or applied in the faculty member's use of academic technology. Table 8 summarizes in tabular form the subjects in rows against the SAC model components in columns, with a 'yes' recorded where the SAC model components have been implemented or applied in the faculty member's use of academic technology, and a 'no' recorded where this was not the case for the subject. Tables 8-12 explore the subject responses to the SAC model variables in more detail, showing specific instances of use or comments by the subject about the application of the SAC model component to their academic technology uses.

COE SAC Model. Overall for COE, Data Visualization, LMS/CMS and Video & Audio were the SAC model components employed most frequently by the faculty members interviewed. Augmented Reality, Education Gaming and Mobile/Ubiquitous Computing were utilized least by the COE subjects. Lecture Capture and Distance Learning/Collaboration in the form of Web Conferencing were described by subjects as base academic technologies necessary to their work, so were added to the model, as displayed in Figure 12a and the Table 3 on the following page.

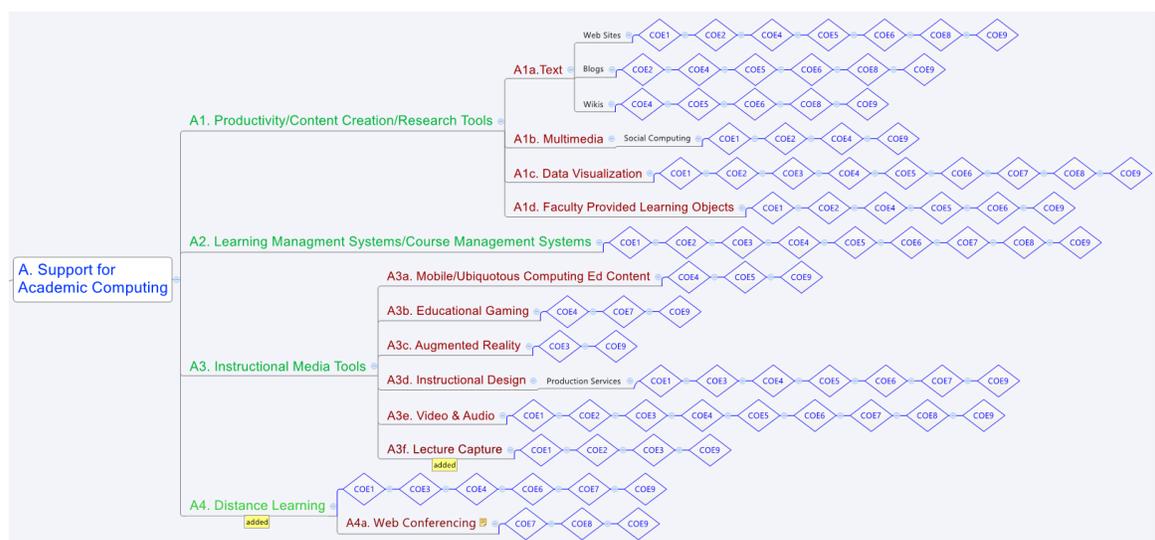


Figure 12b. COE SAC Model results.

Table 8.

Summary Table of Results that Emerged from COE Interviews. COE subjects are listed in rows and grouped in adoption classification based on their usage of the SAC model components listed in columns.

Faculty SAC MODEL VARIABLES														
	A1a. Text	A1b. Multi	A1c. DataV.	A1d. L.O.	A2. LMS	A3a. Ubiq	A3b. Game	A3c. AugR.	A3d. Inst.D	A3e. Video	A3f. Lec.C	A4. D.L.	A4a. WebC.	Total(%) 13
COE1	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	9 (69%)
COE2	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No	No	7 (54%)
COE3	No	No	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	7 (54%)
COE4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	10 (77%)
COE5	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	7 (54%)
COE6	Yes	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No	Yes	No	7 (54%)
COE7	No	No	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	7 (54%)
COE8	Yes	No	Yes	No	Yes	No	No	No	No	Yes	No	No	Yes	5 (38)%
COE9	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	13 (100%)
Total(%)	7(78)	4(44)	9(100)	6(67)	9(100)	3(33)	3(33)	2(22)	7(78)	9(100)	4(44)	6(67)	3(33)	

Trends across the “Adopter” categories for the small sample of interviews should not be over interpreted. However, in these cases, they that reveal that for the COE site, early adopters show a similar overall pattern at 61.6% usage of at least some tools in each category as compared to 61.5% for the late adopters. While the intensity of use may be different for earlier and later adopters as reported by the IT staff with whom they work and from some of the specific comments that can be seen in the sections below, the overall pattern in the presence or absence of use for the basic elements of the SAC model is similar, at least for this small number of cases.

Productivity/Content Creation/Research Tools. Most faculty members in the COE sample have websites for their research and/or their courses in addition to blogs and

wikis as shown in table below. Out of the text-based tools, websites are utilized the most, then blogs and lastly wikis for COE faculty.

In terms of social media, Facebook is employed for recruitment purposes of students who are potentially interested in the program and for communicating program details and announcements. The most prevalent tool is data visualization is directed toward displaying charts, diagrams, word clouds, designs, graphics, and maps. Faculty-Provided Learning objects in COE account for manipulatives and instructional mashups demonstrating concepts.

Table 9.

Summary Table of COE Uses of Productivity/Content Creation/Research Tools

Faculty	SAC MODEL VARIABLES				
	Total	A1a. Text	A1b. Multimedia	A1c. DataV.	A1d. L.O.
COE1	3	No	requirement	data presentation	visuals
COE2	4	Websites linked	Facebook	data, word bubbles	course resources
COE3	1	No	No	graphic organizers	No
COE4	4	Website, blog	Social bookmarking	Word clouds, mapping	Mashups
COE5	3	Blog, website, wiki	No	concept maps	interactive
COE6	3	Blog, website, wiki	No	data graphs	design
COE7	1	No	No	visual data	No
COE8	3	Blog, website, wiki	No	logic models	not digital
COE9	4	Blog, website, wiki	Crowdsource	data reports	manipulatives
Total	6		4	9	7
Average(%)	6.5 (72%)				

Learning Management Systems/Course Management Systems. All faculty use an LMS in one shape or form to disseminate course materials, sharing the syllabus, readings, posting articles and links to external websites as resources. The University of Oregon has licensed Blackboard and many faculty are satisfied with the CMS or they use it because students expect it. Power users of technology find Blackboard awkward in numerous ways, as described in the personal accounts are presented in the table below. Some respondents mention the collaborative features that are integrated into the grade center are very convenient to use as are the assessment components. COE has two other LMSs, one by the name of Oba and the other ZipTrain. Both were developed in-house and serve unique purposes per program.

Table 10.

Table of COE Uses of Learning Management Systems/Course Management Systems

Faculty	LMS/CMS USE
COE1	Blackboard used for 14 years to place all lectures in course documents, syllabi, multimedia video/audio, for grading, uploading tests and assignments and used many tools and determine which one is more functional.
COE2	Use 1% of a lot of what Blackboard has to offer, basic course content, exams, online discussion, posting assignments, reading, links, website, and syllabus, assessments didn't go too well. Had graduate student assistant do moderation of discussion board. Doing more when it felt like a novelty, more on class engagement not online, use to display, grades by posting scores, just send emails twice a week, links embedded in email to keep students engaged as a digest.
COE3	Blackboard and Oba, discussion boards, used Oba once, in special Ed program recognized to do more online learning. Blackboard does certain things very well and other things very poorly, grading assignments, posting materials, journal function, discussion board, announcements. But prefers Oba's discussion board because of layout, a lot of potential within Oba but not a lot of development done.
COE4	Use Blackboard, online stuff with different systems, Moodle, with rural teaching people don't have internet capacity. Blackboard is the most successful, did different discussion groups, blogs, reflections, grading, collaborative tools, and students post assignments, no assessments for a long time - small enough class.

- COE5 Use Obaverse for the coffee shop like tool, use Blackboard (discussion board, clunky with grading). Learning modules initially all transferred into obaverse with help from instructional designer. Likes Oba because of the independent work on 4 modules and due to structure, online module, then in class meeting and switched to a hybrid approach. Students don't like PDFs and prefer reading packets to make notes on. Spring term first with Obaverse use for doctoral seminar. Student posting to forums in Oba.
- COE6 Blackboard used for quizzes, heavy use of the discussion board, groups tool, collaborative, chat tool, test banks, linked out to other resources and policy papers on the web, linked to external podcasts and YouTube videos.
- COE7 Used Oba and Ziptrain and Blackboard. Professor progressed with a lot of bells and whistles. Started with Ziptrain with EMPL, that's where videos and class material is on, and others use ObaVerse put stuff on their with limited resources
- SharePoint (electronic portfolio) is a similar data holding repository like Tk20 (transcript analysis, efficiency) assessments, program based and class based bingers of evidence.
- COE8 Use Blackboard to link to external websites, announcements, email out with hyperlinks, at the end of the day send resources to students to keep them on pace, serves as a common coherent anchor review of what is going on, appreciated by students who are new to concepts and structure. Blackboard has clunky aspects, but instructor often augments Blackboard with own workaround. Students do screencasts and uploading doesn't work, so instructor created UODocs dropbox from via Qualtrics ticket for uploading interface. It's a seamless experience for the students. In Blackboard the discussion board, group, assignment, course documents, disseminate information, grade center in Blackboard is used. It doesn't do a good job of displaying certain videos, wanted to make, tests for a flipped classroom approach, but Blackboard did not have a good codec for videos.
- COE9 Blackboard used at the UO and Sakai at Berkeley and encountered others for workshops to port different content into. Instructor uses grade book, posting materials, posting learning objects for distance site, podcasts, assessments, discussion board, virtual whiteboard, announcement feature, email, group feature.

Instructional Media Tools. Very few instructors in COE use the institutionally supported iClicker, a specific personal response system due to lack of application. Educational gaming has not received much traction yet in COE due to lack of models available to be incorporated, or possibly to limited utility in the field except for creating games in guided instruction in the K-12 environment. The same is true at this point of Augmented Reality: limited use, few examples on which to model use, and limited ideas of how AR could be useful for teaching and learning in the field. Also, both formats of

gaming and AR may still require too much initial investment for it to be practical for individual faculty members to employ at this point.

Based on the provided comments, the inherent nature of the educational field has an emphasis in Instructional Design for teaching, consequently faculty are educated and trained in this area. Nevertheless faculty still prefer a better medium for advertising such production services. Video and Audio is extremely applicable in COE instruction and is used to share tutorials on statistical methods, research and existing examples of

Table 11.

Summary Table of COE Uses of Instructional Media Tools

Faculty	SAC MODEL VARIABLES						
	Total	A3a. Ubiq	A3b. Game	A3c. AugR.	A3d. Inst.D	A3e. Video	A3f. Lec.C
COE1	3	No	No	No	Virage	YouTube	Virage
COE2	2	No	No	No	No	videos	Panopto
COE3	3	No	No	No	Oba	YouTube	Panopto
COE4	3	mobile tools	Yes	No	training tools	YouTube	No
COE5	3	clickers	No	No	lesson plans	streaming	No
COE6	2	No	No	No	hybrid courses	modeling	No
COE7	2	No	Yes	No	No	Yes	No
COE8	1	No	No	No	No	Rich media	No
COE9	5	mobile tools	Yes	Yes	Assessments	Podcasts	Yes
Total	3		3	1	6	9	4
Average(%)	4.5 (50%)						

instruction are embedded from YouTube and other video sharing sites. Lecture Capture was addressed by several respondents and is becoming a trend under Instructional Media. Faculty record their lectures and share them to accommodate for students at a distance, those needing special accommodations, to address attendance issues, or for future reviewing.

Distance Learning. Distance learning is a component added to the SAC Model based on increased utilization. It was not part of the original model (considered outside the scope of the dissertation as described in Chapter II) but a sufficient degree of common usage from the interview data warrants it at least being referenced as included in the model. Many faculty have two groups connecting remotely as a type of web conferencing. Faculty use various tools for professional development and research related collaborations on projects. Distance learning due to the changing landscape of learning and increased accessibility is taking rise as shown below in the table on the next page. Some faculty teach in various physical locations such as from the Portland White Stag building or from the Eugene campus, and the academic technology support affordances allow for better flow of knowledge to reach more students. While full details of this discussion will remain outside of the scope of this dissertation, the data findings reinforcing this need are noted here as an implication for future work. Some programs in COE have a satellite campus where remote students gather to learn from an instructor on the main campus.

Table 12.

Summary Table of COE Uses of Distance Learning

Faculty	SAC MODEL VARIABLES		
	Total	A4 DistanceL.	A4a. Web Conferencing
COE1	1	International	No
COE2	0	No	No
COE3	1	Yes	No
COE4	1	Yes	No
COE5	0	No	No
COE6	1	many courses	No
COE7	2	Yes	Go to Meeting
COE8	1	No	For Projects
COE9	2	A lot	For Projects/Collaborations
Total		6	3
Average(%) 4.5 (50%)			

Themes

Upon reviewing the interview data, five common patterns emerged regarding gaps perceived by many of the respondents relative to accessing academic support for SAC IT.

The five themes involve:

- Need to better advertise services and how to access them.
- Limitations in funding or unclear sources of funding for usage of the resources.
- Limitations in the IT infrastructure overall.
- Limitations in the LMS services and functionality available for instruction.

- Limitations in specific IT tools.

Summary data regarding the themes are presented in Table 13. The five themes are described and discussed in turn by each theme in the sections below.

Table 13.

Summary Table of Themes and Patterns from Faculty Interviewed. Case number of the interviewee is recorded in the AAA and COE columns. Case numbers listed described substantial gaps, issues or problems in the areas of the themes, as barriers to utilization of SAC IT.

Theme	AAA Faculty	COE Faculty
Need to showcase usage, services are not advertised, technology not accessible	1, 3, 7, 8, 9	2, 3, 5, 6, 7, 8, 9
Limited/unclear funding (support/resources)	1, 2, 4, 6, 9	3, 4, 5, 6, 7, 9
Limited infrastructure	1, 2, 3, 4, 5, 6, 8, 9	3, 5, 7, 8, 9
Limitations in LMS functionality	1, 2, 4, 5, 6, 8	3, 5, 7, 8, 9
Limited tools	1, 5, 8, 9	3, 5, 8, 9

As an overall summary contrasting the two units in the five themes, in most areas, there are similar patterns across the two units with regards to foundational disparities that faculty describe regarding the five themes. However, COE respondents described more issues with the need to know more about what services are available and how to access services, while the AAA respondents described more absolute limits in the infrastructure available. In other words, AAA respondents seemed to believe they knew the extent of resources/support available and found it insufficient in certain areas, while the COE

faculty interviewed showed more tendency to believe they did not know what services were available in the first place.

Need to showcase usage, services are not advertised, technology not accessible. The influence of technology on campus has evolved instructional practices. Faculty from both COE and AAA provided commentary that reinforces the imperative need for evaluating the use and accessibility of educational technology. AAAA1 stated that he/she felt the department was technology averse, so the interviewee didn't want to waste time debating. He/she would prefer that once a term someone would reach out to them sharing what's new in digital humanities. This consistent outreach would reinforce academic technology as part of the university mission to serve “as a catalyst for curriculum improvement and change across the university by building and sustaining relationships with faculty, chairs, and deans around strategies and programming that facilitate innovation in curricula” (Albright & Nworie, 2007, p. 65).

AAA3 mentioned how he/she was looking for assistance for developing a research website, but was not aware of what was available. AAA8 was also unaware, describing experiences of services not advertised and most typically known only by word of mouth. The ability to support appropriate interactions is essential if institutions are to meet the needs of the 21st century learner and teacher alike.

COE2 believes that most faculty get very little instructional training unless they are specifically specializing in technology in education, so bringing in technology into the mix is challenging because the instructors are unaware of the capacities of implementing technology into their teaching. Therefore instructional designs are needed for user-authored systems to concentrate on creating a usable “environment” where

instructors are guided to produce lessons (Weston, 2004, p.53). COE3 and 5 mentioned how there was no training provided and they had to figure things out independently. The loss of time and effort became a major barrier. COE5 said, “No one can walk into the institution and figure out where the support for resources lie.” COE6 had similar experiences:

There is no proactive outreach to faculty regarding tools of interest. Therefore the instructor would like to see more information pushed to faculty. And has been frustrated for technology support; it exists but not easy to access. There is a process but that information doesn't get passed around. Faculty have to be involved in the loop therefore new faculty go for months until they get plugged in. You have to go looking for support and things took forever to get it resolved.

Often, respondents said, instructional designers enter the process late in the development or not at all. The faculty members operate alone to make decisions about content early in the design process, but the ultimate assessment of fit does not occur until a lesson is implemented. This leads to a large investment in development taking place without sufficient advance design to help ensure that the ultimate outcomes will be successful. COE7 believes instructional designers need to be present to critique the instructors and as a guides for use and discovery mode regarding technology-enhanced instruction.

The research literature supports that instructional designers and content experts can help design and evaluate lessons “delivered” by technology (Dick, 1996). As the mantra says in the field, the individual faculty member “doesn't know what they don't know” With no one to help evaluate instruction and provide suggestions, there is often insufficient knowledge present of what is possible and how to improve it.

As a result, respondents from both units described, the faculty are having to be problem solvers in areas with which they can spend little time and may have little

knowledge. However unless faculty as developers are steeped in context and content problem-solving regarding the use of technology, they have a narrow window.

Respondents especially in the COE describe accessing the expertise as being at type of networking, known in the field as being all about “who you know who knows something.” Respondents report there is no open forum to disseminate and collaborate.

COE8 feels services are scattered at COE saying that he/she had to contact someone for one thing, then he/she had to contact other people, hence it was not clear where services were and who did what. As described in Chapter I, a fragmentation of academic technology across support services often occurred in prior years in higher education at many institutions. The respondents here report it continues in some contexts today.

Just-in-time support is described by some respondents as ideal. COE8 has created his/her own data management and would like a brief vignette of how an instructor is using various tools. Examples are helpful, the respondent reported, when faculty have never seen the functionality. It would be helpful to faculty to see examples in use, to better draw upon what is known and foster interest in use.

Limited/unclear funding (support/resources). The complexity of support for students, faculty and staff is an ongoing discussion continues to evolve over time. AAA1 shares how the department was technology averse, so they didn't want to approach administration because it would not lead to an outcome. “It was not clear where funding was coming from.” (AAA2) There is support needed for academic computing in a given context, the existing operational capacity to support these needs, and the decisions and

leadership by policy-makers to bring these into appropriate alignment continues to be a daunting challenge.

The underuses plague all IT at an institution of this size. There are not enough people or money to satisfy everyone. I have an openness to technology but I am also familiar with how policy levels are not always in congruence with institutional policies and legal frameworks... (AAA4)

Due to their research focus, higher education institutions often are trend-setters when it comes to application development and use. Such technologies “create new capabilities and new ways of organizing the higher education mission, information resources, and services” (Katz, R., 2002, p. 54). With such an encompassing mission and the wide availability of resources, institutions can accomplish more with technology services:

“Educational Technology is a complex, integrated process involving people, procedures, ideas, devices, and organization, for analyzing problems, devising, implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning.” (Ehrlich, D., 2002).

AAA6 participates as a personnel member on the UO Web Developers Group and feels there is a need for more developers. The lack of funding limits the expansion of this type of resource. With a shortage of developers that spans across campus there are lack resources to build new tools for engaging users.

The problem in large shared use facilities is lack of shared electronic classrooms. UO is woefully inadequate in its provision of support for statistical computing on campus, and the ones who are doing that get external research. And students are in as difficult and worse position than faculty. (AAA9)

Due to the complexity of implementation, having a base model, or minimal sufficient model, in place could help to assist institutions in covering many of the basic needs of academic computing. Communities of practice and learner groups that form

around open content provide a source of support for independent or life-long learners (NMC Horizon Project: 2010 Preview, p.3).

There was no training provided here and I had to figure things out independently. There are not enough smart boards in college, but there are plenty in schools, so can't prepare teachers. This does have a negative impact for quality of training for future teachers to be. Lack of awareness of support available is a hindrance. There is a reduction in the quality of online education due to lack of resources. (COE3)

Due to lack of funding, services are not being advertised well which impinges upon access and use of necessary resources. "Support is not immediate when needed." (COE4) "No one can walk into the institution and figure out where the support for resources lie." (COE5) According to Kramer & Maughan (2001), it is a challenge to integrate technology across campus; therefore, key stakeholders such as IT managers, administrators, faculty and students need to be given the opportunity to provide feedback for improving communication and information systems. Many institutions have faculty senates where major technology decisions are put on the table for discussion. Katz, R. (2002) suggests that leaders must articulate an institutional/organizational vision that grants widespread access to IT services. Kramer & Maughan (2001) echoes a similar concern in which administrators, deans, directors, department chairs, and faculty are out of sync with their communication and information systems staff (p. 85). Faculty meetings offer a platform to share IT support needs, but the increasing complexity places new demands on policy planning strategies:

One of the most complex areas of impact associated with the emerging infrastructure is the policy arena. New technologies create new capabilities and new ways of organizing an institution's mission and information resources and services" (Kramer & Maughan, 2001, p. 98).

Reasons for slow adoption and implementation include limited or problematic access to resources (e.g., appropriate hardware), high costs, and poor technical support in

schools, as well as reluctance on the part of teachers to change tried-and-true instructional practices and take risks with new technology (Weston, 2004). This then leads to conclusions about how the layers of support, though they may have their unique challenges, must overlap and inform each other.

You have to go looking for support and things took forever to get it resolved. There needs to be more consultation services housed near departments. Centralized services don't work given the scale of departments. There is a big gap. People need to have that expertise in educational technology with leadership. They don't invest. ED TECH fee gets buried. The dean would say repeatedly that they don't know anything about technology. They appoint people to committees who don't know how to measure that knowledge; and administration needs to understand that. Bottom line is that there is a need for more people and more resources. (COE6)

Albright & Nworie (2007) similarly suggest that academic technology issues and requirements be incorporated into the university's overall technology plan in order to actively promote the use of technology in support of the educational and research mission of the university. Having technology as part of the university mission necessitates “building partnerships with the faculty senate, library, information technology, faculty development center, distance/continuing education center, and other campus areas as appropriate to work collaboratively toward achievement of university strategic goals that can be addressed by instructional technology” (Albright & Nworie, 2007, p. 65). The mission can only encapsulate what the college stands for if the leadership is cognizant of the departmental and faculties needs and can deliver.

I am pressing the edge of what the university is thinking of and what the department is not capable of therefore. I have to invent solutions to make distance instruction work. There is very little investment at the university level for forward thinkers. The policy is not there because faculty are not sure if the material they produce is protected, which constrains people with what they can do. (COE9)

The (WASC) Western Association of Schools & Colleges (2000) defines educational technology as a systematic way of designing, carrying out and evaluating the total process of teaching and learning (p.2). WASC also lists how technology is used in teaching and learning for delivering education, learning about computers, distance education, providing access to learning resources, curricular use, facilitating student learning outside of the classroom, and enhancing the quality of learning and the administration of courses. If leadership was familiar with these organizational standards then faculty would have more support in reaching their instructional goals.

Limited infrastructure. Regarding the “Limited infrastructure” theme, AAA5 felt inhibiting factors for his/her use of educational technology included physical and network infrastructure, which includes the movement and storage of large files. AAA6 also added that the lack of infrastructure relates to servers, and that the server environment was not well supported or sufficient for the work of collaboration and file sharing of large projects. Projects in AAA can be in 2D or 3D media, and may include animations, video and other extensive use of media. The transfer, storage and archiving of the large files becomes a challenge. Often faculty are working with students on portfolios, which then need to be managed and this includes the ability to establish accounts, permissions, and identity management for portfolios that may exist over time and between classes. Access may need to be available to both instructors and students involved with courses, and also other audience members and stakeholders more externally situated. These individuals may not have university affiliation, and may not be able to access some of the usual resources that faculty use when working with student work.

AAA8 expressed that part of the infrastructure issue had to do with the pedagogical practices employed in the architecture field, which puts an emphasis on a collaborative “studio” environment where extensive media can be displayed in large presentation formats:

I have read the literature on this topic and feel there needs to be more educational equipment, and pedagogy is lacking. Because learning happens in the studio environment and these studios are the least technologically advanced. The studio is weak, has a small TV screen & table, no space to brainstorm or whiteboard... The studio is key in design but innovated the least, there are disconnected experiences due to lack of infrastructure (no Wi-Fi, printer...) (AAA8)

Educational technologies can enhance, enable and extend teaching and learning environments. However, domain specific needs such as described by these interviewees can tax the educational technology infrastructure, and increasingly make demands that institutions are poorly prepared to meet.

Interviews that described infrastructure issues also discussed that when used appropriately, educational technology can be especially helpful for those with disparate learning needs. However to take advantage of the benefits of technology, every institution requires a solid infrastructure to maintain instructional support for individual needs such as accessibility for all students, an issue which faculty members must address in their teaching as well as in their research programs.

Individualism can also appear in other contexts. COE7 says that there is poor technology infrastructure to nonexistent in the unit for a variety of needs, and that each department is its own fiefdom; faculty create things individually, but there is limited mechanism to share the developed resources or educational technology solutions.

As these comments point out, a range of technical and institutional administrative and academic support issues arise in providing a sufficient IT infrastructure. For instance

these may include data storage, maintenance (as shown in Figure 3), and technical troubleshooting, as well as institutional buy-in, openness for integration with other systems, budget allocation, and administrative support as the plethora of factors involved. Wada & King (2001) conclude that accepting an inclusive model of IT infrastructure incorporates not only the technical assets but also the human process and organizational elements regarding policies is necessary.

Limitations in LMS functionality. Learning or Course Management Systems exist in one shape or form in most institutions of higher education at the current time to disseminate information as well as to establish collaborative learning settings, assess users, and manage course information such as grades. The learning management system (LMS) is described as a commodity business by COE9:

The LMS/CMS is mission critical because of virtual teaching... Very little investment is at the university level for forward thinking. There are many elaborate tools but faculty are on their own to figure out for most part.

LMSs of various types and with a widely diverging degree of functionality and price points are appearing steadily. However AAA4 sees limitations in the LMS adopted by the campus, Blackboard, as not a limitation of the actual LMS but of how it is run on campus. Faculty are concerned about which license is purchased, because basic editions offer less than more advanced versions of the LMS software. AAA4 explains that faculty try to figure out how to work within the provided LMS environment, then if it doesn't work sufficiently well for their purposes, they move on. AA4 describes:

“Not used for 4 years, partly for longitudinal blog site = porous, fulfill vision for teaching not bound by terms, use Blackboard only to email (convenient).”

Respondents describe that learning management and course management systems provide a set of integrated tools for assessment and evaluation, content management and delivery, communication and collaboration and course administration. Their use has increased institutional capacity for delivering web-based learning, and to include online or hybrid elements in face-to-face courses, describes AAA8:

I use Blackboard to mostly post readings on, use assignment tool, grade center and for student viewing, blog didn't work as discussion board, reading reactions, and assignments are large file size because of graphical content so use AAA space.

Because LMS tools adopted by a campus tend to be generic, use of learning and course management systems cuts across disciplines and sectors. AAA6 describes using Blackboard since 1999. "It's great for distant learning but not for studio class. If you are in art why use Bb if you can't customize it." Respondents describe that such systems represent an opportunity and a challenge.

Similarly to other campuses, in the units studied, large numbers of faculty are placing a variety of course assets such as lecture notes, presentations, publications, online textbooks, multimedia activities, sets of web links, assignments, and tests into such systems. Many students are participating in discussions, taking tests, turning in assignments, and developing portfolios. AAA2 describes setting up a WordPress installation for an eportfolio system. Then once that had been established they transferred their Blackboard courses to that Wordpress instance to achieve needed functionality. WordPress is a flexible blog like environment that allow technologically savvy faculty to customize.

With their large user bases, there is tremendous potential for the learning management system to form a basis for exchanging content and best practices. "I used

Blackboard for convenient storage and organizational device, rather than other features, because investment in time in managing those resources is high and time constraint,” described AAA9. 89% of the AAA faculty sampled use an LMS, a strong percentage of the total. An even greater use case is the 100% of the interviewed COE faculty who rely on LMSs making it a core part of the SAC Model.

However, while more faculty and programs have come to rely upon course management systems over the past few years, and almost all respondents here agreed that they are employing such systems, rapid technology and business changes (mergers, elimination of products, etc.) have brought about a sense of discomfort in the community (Wiley, 2003, p.59), reflected as well in the interview comments, such as by AAA1:

Blackboard heavy user, not willingly. And reluctantly using it, features clumsy, blog tool painful to read, discussion boards not user friendly. Have students upload audio files using the assignment feature, concerned about it crashing, but has clean grading.

The CMS facilitates a striking reduction in the need for maintaining and supporting multiple platforms to address specific pedagogical purposes. However, faculty usage patterns in the interviews show that one size does not fit all, as COE8 shows:

Blackboard has clunky aspects, but instructor often augments Blackboard with own workaround. Students do screencasts and uploading doesn't work, so instructor created UO Docs dropbox from via Qualtrics ticket for uploading interface. It's a seamless experience for the students. In Blackboard the discussion board, group, assignment, course documents, disseminate information, grade center in Blackboard is used. It doesn't do a good job of displaying certain videos, wanted to make tests for a flipped classroom approach, but Blackboard did not have a good codec for videos.

COE3 and COE 5 both agree that Blackboard is complex and the discussion board and grade center are problematic and awkward for their usage. Digital resources, specifically web-based learning content, are a growing and pervasive component of

instructional delivery in higher education. And with that the creativity of presenting course material is increasing. Students can be reached in different ways and could be provided the tools to take more control of their environment. However, to add interactive components like discussion boards or quizzes, a high technical skill level was required, and even then often the LMS system provided did not work correctly. For early adopter faculty members, such components of the LMS system seem to feel more like “trial” software than fully developed products that can be operationally and reliably employed.

Limited tools. Tools for content creation that lead to productivity gains and improvements in both instructional and research programs are described in the SAC model. Interview respondents described that the stability and availability of tools has become a problem, such as in the words of AAA1:

Because of the lack of research based use of new technologies there aren't very many existing tools to use. If there was an instructional designer out there recruiting faculty to use tools, faculty will adopt them. I was upset about migration of tool to another, because tool would cease to exist and would have preferred to be informed about tool availability in advance, so we can decide whether to invest in it. A lot of time and energy is put into investing in the tool there would be payoff if that tool were to be available long term.

User-authoring systems (such as presentation software, authored simulations and authored assessments), allow instructors to use “on-screen tools (menus, prompts and icons) that let users enter text, compose graphics, and prescribe branching” (Locatis & Al-Nuaim, 1999, p. 66). These tools in turn make content dynamic, allowing students to better engage with interactive material. With its instructional context, these authoring systems allow teachers to design their own lessons with forms and templates, select different functions of an application based on need, and choose content from reference

tools. AAA8 describes how the rapidly expanding opportunities mean he/she can't even scratch the surface, even with help from students in the faculty member's research group:

I prefer to have access to a tools list with applications associated with the tool, a database of sorts. I have a Ph.D. student who is coming in to study technology in community engagement, therein turn suggesting tools and other resources which are needed for collaboration, apps discovery therefore we haven't even scratched the surface of resources.

The instructional design for user-authored systems concentrates on creating a usable environment where instructors are guided to construct lessons. AAA9 believe that the curriculum needs to be altered to accommodate for tools but faculty need to initially invest in a steep "adoption curve." Tools must be investigated, identified, taught to students, established as stable, reliable, accessible and secure, and incorporated into lesson plans and a wide variety of potential teaching activities. This all takes time and such investments can't be discarded too rapidly or they don't pay off, or are not feasible. COE6 mentions how there is no proactive outreach to faculty regarding tools of interest, which only makes this adoption curve steeper.

Documents and other content created with newer technology tools have become easily sharable for collaborative creation. COE7 suggests that collaboration tools need to be used in administrative meetings because not everyone is knowledgeable about tools, and others have varying degrees of use. Tools for working collaboratively at a distance are easier to use and more commonly available than in previous years. Online conferences are a convenient form of professional development. As tools have matured, so too have the practices of online communication and collaboration. The collaborative trend is at the heart of social computing driving personal broadcasting (The Horizon

Report, 2006, p3). The interoperability of these tools enhances productivity amongst users.

Capturing and visualizing student data may enable teachers to make better decisions about what and how to teach. The expectation is that tools for gathering, reporting, and visualizing educational data will make it easier to understand where programs are successful and what improvements can be made. Graphic representations of data are popular because they open up the way we think about data, reveal hidden patterns, and highlight connections between elements. Traditionally, researchers designed visuals to make trends clear to an academic or lay audience. In both COE and AAA these tools are utilized and valuable, as described by the interview data. Such easy-to-access tools could simplify the interpretation of complex data sets and encourage cross-disciplinary interpretation. Whereas visualizations were once too complex for quick assimilation, tools that create interactive visualizations provide users with some measure of control over how—and how quickly—information is presented, making complex patterns easier to perceive and understand.

CHAPTER IV

DISCUSSION, CONCLUSIONS AND IMPLICATIONS

This dissertation proposes a logic model, the Support for Academic Computing Model (SAC), see Figure 6 in Chapter I. The SAC model describes aspects of the ideal *minimal* academic computing program. To date the model derived from a literature synthesis of necessary technologies within the scope of my research includes three components that are within the scope of my research here: Productivity/Content Creation/Research Tools for universities, Learning/Course Management Systems (LMS/CMS), and Instructional Media Tools. Lecture Capture and Distance Learning/Collaboration in the form of Web Conferencing were described by subjects as basic academic technologies necessary to their work, so I added them to the model, as displayed in Figure 12a and the Table 3. Having these components enhances the SAC model given the increasing amount of utilization. More and more instructors, learners and researchers are using remote technologies to connect to knowledge and share information due to the ever changing educational technology landscape.

My hypothesis is that empirical evaluation studies based on a comparison with a minimal base logic model for infrastructure needs across contexts may help to provide information to better align resources for academic support at the college-and school-level in higher education. The goal of the work was to interview faculty about their academic technology use at two different college/school sites at a single university, examine the responses at each site in relation to the SAC model, and address a set of four research questions. This chapter will now turn to addressing the four research questions based on

the reported results in Chapter III. The data collected brings me into agreement with my hypothesis.

Research Question 1: How comparable is the educational technology infrastructure of the University of Oregon College of Education (COE) to the academic computing model?

Figure 12b and Table 8 in the previous chapter display how Augmented Reality used at 22%, Education Gaming at 33% and Mobile/Ubiquitous Computing at 33% were utilized the least in the COE, based on the interviews. For resources used most, Data Visualization was reported as utilized by all faculty members interviewed at 100%, LMS/CMS at 100% and Video & Audio at 100%. Lecture Capture used at 44%, Distance Learning at 67%, and Web Conferencing at 33% are suggested to be potentially added to the model because faculty used these technologies as well.

For COE, the patterns of usage are somewhat indicative of the discipline that aligns with the mission statement, though certain Instructional Media Tools could have been explored more by faculty. Due to lack of resources, applications of Educational Gaming, Augmented Reality and Mobile/Ubiquitous Computing were the least used and could have relevance to instruction. Educational gaming is beginning to be used extensively for K-12 settings for deploying tools to engage students in learning concepts. Of course, certain tools may be more suitable for specific programs in COE, such as the Educational Studies (EDST) program, listed in Figure 14, might wish to employ more gaming in teacher training if teachers in K-12 schools are increasingly working with this type of instruction with their own students. This type of reasoning may warrant Educational Gaming remaining in the SAC model. Augmented Reality based on its

perceived lack of utility at the two study sites may be questionable to remain part of the SAC Model, although monitoring its emergence may be warranted.

Due to modern times and increased educational demands, Distance Learning needs to be explored more and better resources provided due to over half of the faculty interviewed using it.

Additionally, one would expect that there would be plenty of Instructional Designers employed at the COE based on the 78% of faculty utilizing those skills/services. Yet it is not apparent in the IT information provided that this type of support is systematically offered to faculty members in the COE, indicating that faculty may be left to their own resourcefulness, research grants, or use of limited departmental funds to obtain the needed services in these areas. Interviewees do report that due to the innate educational foundation of the discipline, faculty are expected to know how to teach in whatever modality they are assigned to support, but they are not necessarily effectively prepared with technology, hence instructional design is needed.

Data Visualization is a necessary means used to present data in a manner that is easily interpreted and understood. Faculty by training have all used these tools to analyze research and display data in meaningful ways. Video & Audio come hand and hand with media rich instruction and are employed frequently to engage users by presented concept in dynamic manners. A solid LMS must be available to incorporate all facets of instructional technology for faculty given the overwhelming reliance. Therefore having a robust model in place that provides fuller support for all of these three mission-critical areas seems essential based on the COE interviews.

Research Question 2: How comparable is the educational technology infrastructure of the University of Oregon School of Architecture and Allied Arts (AAA) to the academic computing model?

Referencing Figure 12a and Table 3 in the previous Chapter displays how Augmented Reality used at 22% and Education Gaming at 22% were utilized the least in AAA. By contrast, Data Visualization at 89%, Faculty-Provided Learning Objects at 89%, LMS/CMS at 89%, and Video & Audio at 89% were employed the most. Lecture Capture at 22%, Distance Learning at 56%, and Web Conferencing at 22% might profitably be added to the model because faculty used these technologies as well. Most faculty in AAA utilize Learning/Course Management Systems (LMS/CMS) at 89%, then Productivity/Content Creation/Research Tools at 83%, and as an extension Instructional Media Tools at 46% making them a core part of the SAC Model.

The patterns of usage are mostly indicative of the discipline but in order to better align with the mission statement, most likely the Instructional Media Tools should be employed more especially by the late adopters or more traditional users. For AAA, there was a substantial difference between the usage profile of the two adopter categories.

Given Educational Gaming's extremely low use, there is question whether it serves utility in the SAC Model for this unit. Certain programs may have more use for applications in Augments Reality and faculty have presented interest in exploring these tools, hence having it part of the SAC Model may be necessary, even with low rates currently indicated.

In order to allow for more collaboration, Distance Learning tools are needed for faculty to easily establish these connections. Ubiquitous computing is very strong in AAA due to the permeability in its program's application. Video and Audio are essential

to the arts and having support for content creation such that serve as Faculty-Provided Learning Objects is vital for the SAC Model due to how students learn in this domain with a studio model and by engaging with dynamic content. Relying on an LMS/CMS to contain all course content and allow for students to engage in learning is fundamental and mission-critical, based on the results of the interviews. This is consistent with the literature in Chapter I.

Due to the lack of infrastructure not all areas of AAA appear to be equally enhanced with what educational technology has to offer. The computing benefits are enormous, but the deficiency of creative space in a virtual realm are perceived by faculty interviewed as hindering exploration of digital assets. The gamut of instructional tools that allow art to be manipulated appear to be underutilized.

Research Question 3: What proportion of the available educational technology infrastructures in (1) and (2) above are utilized by faculty in COE and AAA?

Figure 13 is a compilation of SAC model results as a cross comparison between the two sites. Figure 13 gives a graphic depiction of the reported use of the SAC model academic computing resources for the interviews across the two study sites. The upper bar for each SAC model component shows the AAA results for the nine interviews, and the lower bar shows the COE results for the same components.

Strikingly, given the different missions of the two organizations as described in Chapter II, the interview profiles show many commonalities. Overall numbers reporting usage are quite similar between the two sites, although there tends to be more variation between the two adopter categories in the AAA context and more consistency in the COE context. This of course may be an artifact of small sample size, and would need further

replication and study for interpretation. If trends persist, they might relate to several potential factors, including the perceptions that more pedagogical knowledge including technology-related teaching is expected of all faculty in the COE due to education being the direct research focus of the discipline, or the result of COE faculty being reluctant to report under usage, as data are self-report data. Such trends might also indicate the range of potential tools attractive to early adopters is more emergent in AAA, especially given the visual, 3D, collaborative and studio nature of the work.

It is fascinating to see how much overlap there is with regards to the use of academic computing between AAA & COE. I do agree with my hypothesis in that the cases are different but share a linked overlay factors. To take for example the first area of Productivity/Content Creation/Research Tools, use appears similar, with the College of Education at 72% on average, showing somewhat more use of wiki knowledge bases, and AAA at 83%, reporting more use of multimedia and faculty-provided learning objects. (Sample sizes are small, however, so note the limitations of such comparisons.) By contrast, reported use of data visualization, web sites and blogs was quite similar.

About 89% of AAA faculty report using Learning Management Systems/Course Management Systems whereas 100% COE faculty do. Since AAA has various programs that are not taught in a standard classroom environment, LMS utilization may not be as relevant hence not used by all faculty. For example, the advanced graduate architecture courses may have less use for a traditional LMS because students are at the stage of using computer simulations to draft designs that will be presented in a studio space on a weekly basis.

About 46% of AAA faculty use Instructional Media Tools whereas 50% of COE faculty do. These numbers are very close and the proportion of utilization could vary due to type of content the instructor is teaching. AAA has the Department of Planning, Public Policy and Management and courses taught in that program are of a different nature than other art related programs, which may lead to lower uses in Instructional Media tools. The faculty member I interviewed in that program, for instance, is tech savvy but did not find any need to utilize these tools in the course.

About 39% of AAA faculty use Distance Learning whereas 50% of COE faculty do. Several faculty members expressed that AAA programs require in person activities that are hands on hence not as much web conferencing takes place. COE programs do more consultation with regards to educational standards and assessments with various agencies and institutions. There are also more diverse programs abroad which collaborate with the COE, hence having stable Distance Learning solutions in place is valuable. Also COE has licensed Panopto, a Lecture Capture tool for their faculty which contributes to supporting increasing utilization.

Both organizations showed similar profiles for these components in many ways. It was interesting to note both the use and the potential underutilization of the available technologies. In no category was the capacity used by every instructor, except for Data Visualization and Learning Management Systems in the COE, and Video & Audio resources in both units.

The numbers present that COE faculty report on average 62% utilization of at least some aspect of the SAC elements, whereas 59% of AAA faculty do. While not a substantial difference, the direction of the difference may be surprising based on the fact

that the amount of support per faculty members appears to be substantially higher in AAA. However, COE faculty report various less standardized ways by which support may be obtained, probably significantly expanding the actual resources available to at least some faculty members. COE faculty also may have more expectation given the domain field is education that they self-solve with little or limited support. Another factor, of course, could be the exact sample that was interviewed. Figure 13 displays the overlay of number of faculty utilization per component.

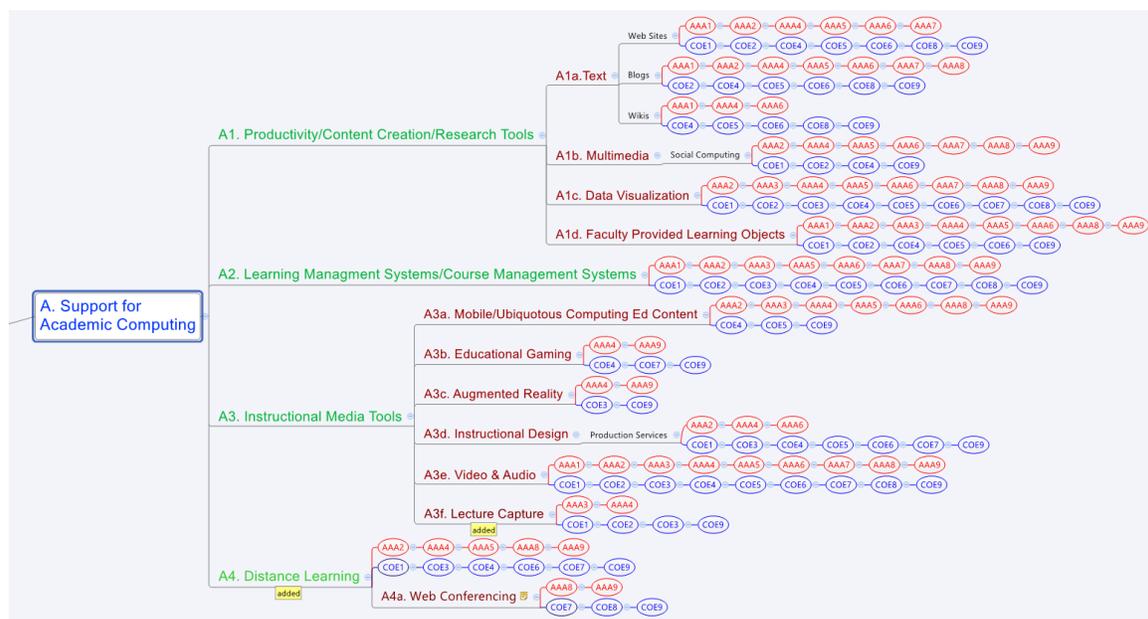


Figure 13. COE & AAA SAC Model results.

Interpreting COE & AAA SAC results. Given this, the logic model allows an analysis of COE and AAA’s resources available for academic computing, for the model elements and the interviews obtained.

In terms of the academic support issues reported in the interviews, five major themes emerged and the results were discussed in Chapter III. They are summarized here in short as the need to advertise services, clarify limited or unclear funding, enhance limited overall infrastructure, enhance LMS functionality limitations, and enhance at least

some technology tools that are perceived as limited for needs in certain units. More extensive professional development was also mentioned in some of the interviews, but has been defined as outside the scope of this research except for immediate training needs for tool, infrastructure or support use as described in Chapter II. The larger picture of for instance preparation in overarching principles of instructional design are acknowledged as an important part of faculty teaching responsibilities but are beyond the scope of a minimal model of academic support as defined here, and are left for future work.

Results across the trends indicated that availability of the support services or availability of the technology itself was often not advertised, widely known, or accessible in the units, especially as reported in the COE, where faculty often described confusion about what was available to them. Both units reported limited or unclear funding for technology support. The majority of faculty interviewed across both units reported serious limitations in the LMS functionality. Some reported limitations more generally in technology tools, and AAA strongly reported limited infrastructure overall, especially in regard to their studio models of instruction.

As displayed in Figure 13 above, faculty seem to use what they can within the scope of their instruction. If instructional designers and subject specialists reach out to customize technology to meet specific curricular needs, this might have tremendous implications for faculty use. A majority of faculty share that they have underutilized what is available mainly because they don't have time or knowledge of the resource.

There are prominent similarities and differences between COE and AAA in other respects as well. Physically, AAA's facilities are dispersed across multiple buildings.

There is a presence for AAA on the north side of Franklin Blvd, Lawrence Hall, Pacific, and PPPM located in Hendricks Hall.

COE has various buildings dispersed as well. New and recently remodeled buildings such as HEDCO, LOKEY and Clinical services are somewhat dispersed like AAA but the buildings are closer physically. Various programs have moved into the new structures and some of the older buildings were remodeled and renamed, so these more recent changes have left somewhat less understanding of what academic support programs do exist and where they might be located.

In addition, COE's structure is quite complex with all of the various educational units out of the 18 different specializations under four programs as shown in the figure below. All of these specializations may have some unique needs for academic computing, especially due to the nature of their work with outreach along with teaching and research. Also the reported total number of faculty (combined) across COE is larger than AAA, making the size of the support and communications challenges also larger.

In terms of obtaining academic computing support, COE faculty in the interviews frequently reported not knowing where to go to get help for their support needs. Within the past few years, COE has added a new IT Director. However, the services that do exist throughout the College seem to be somewhat decentralized. Faculty report it is difficult to track down the right individual when there is need. Services are distributed among programs, departments and College level support, as well as at the University level, but with perceived limited coordination or communication between and among the various resources available.

CPHS: Family and Human Services--Undergraduate Major
 CPHS: Counseling Psychology--Doctoral Degree
 CPHS: Couples and Family Therapy--Master's Degree
 EDST: Added Subject Endorsements & Authorizations
 EDST: Critical and Sociocultural Studies in Education--Doctoral Degree
 EDST: Curriculum and Teacher Education--Master's Degree
 EDST: Educational Foundations--Undergraduate Major
 EDST: English for Speakers of Other Languages
 EDST: Reading Endorsement--Multicultural/Multilingual
 EDST: UOTeach K-12 Teacher Licensure & Master's Degree in Curriculum & Teaching
 EMPL: Administrator Licensure Program
 EMPL: Educational Leadership (Canada)--Master's Degree
 EMPL: Educational Methodology, Policy, and Leadership--Doctoral and Master's Degrees
 EMPL: Reading Endorsement Program--Literacy Leadership
 SPECS: Communication Disorders and Sciences--Doctoral and Master's Degrees
 SPECS: Communication Disorders and Sciences--Undergraduate Major
 SPECS: Early Intervention and K-12--Master's Degree
 SPECS: School Psychology--Doctoral Degree
 SPECS: Special Education Undergraduate Minor

Figure 14. Academic Departments and Programs in COE (Woodbury, 2013a)

AAA on the other hand has all of the central support located in one building, Lawrence Hall, and this has been the case for decades. So while AAA also has numerous departments and programs, the knowledge of shared support and where to go to get support for academic technology seems to be more entrenched. Also, the planning for the shared support seems to be more involving of the departments directly, including the Department of Architecture, Department of Art, Department of the History of Art and Architecture, Department of Landscape Architecture, and Department of Planning, Public Policy and Management. Associated programs include the Arts and Administration Program, Digital Arts Program, Historic Preservation Program, Interior Architecture Program and Product Design Program.

The amount of support staff also seems to differ between the two colleges, at least based on data reported by COE and AAA, and by the campus, as shown in Table 1. With

the smaller number of total faculty members reported and the larger number of technology staff members, AAA appears to have a ratio of about 36 faculty members per each technology support staff member. By contrast, COE has a reported estimated ratio of about 69 faculty members per each technology support staff member, nearly twice as high. This does not account, however, for the various part-time workers, student support staff, research center or outreach center support services, or other individuals with technology-related duties assigned to them that many of the COE departments, programs and centers rely on for technology support. As noted in Chapter I, staffing is an important issues because it is part of what determines how much instructional technology outreach can occur.

Both COE and AAA have satellite campuses for students in Portland and elsewhere and manage diverse needs, as reported extensively in interviews, for instance:

The instructor experimented with Vidyo and hybrid teaching, to serve Portland and AAA. They translocated themselves with technology and Vidyo to bridge that. Infrastructure issues with classroom and network for that technology, limitation and as teacher limitation with how much technology can one person juggle in classroom. It was nice to have a staff to manage technologies. Need to add web conferencing, cross compatibility and integration. (AAA2)

There are tools in place but they may not always work reliably and there needs to be solid support around how to use them effectively. “AAA can do a better job with collaborating with Portland which is difficult due to lack of video conferencing.” (AAA8) The solutions in place do not always scale properly and faculty become frustrated when collaborations are limiting due to infrastructure, but growing expectations push the need to use the services:

They don't see any inhibiting factors, except would like to do nicer video tapes for learning things and there is an inherent cost and COE does not support for SPECS entirely. There is support for faculty there but instructor needs to make an effort in tracking it down. Support is not immediate when needed. The instructor needs to use a phone to make calls to reach rural community or via emails, blog and physically send video tapes out to disseminate information. (COE4)

Reaching out to diverse groups of learners is difficult when mechanisms are not in place:

Professor works with ETS with testing and test accommodation. All people are using technology to deliver assessment and we are asking is it equitable across and how can we make it so? (COE7)

The findings confirm aspects of what is presented in the literature in Chapter I, about how fragmentation of services can occur. The literature reports this is common in higher education among media centers, IT and academic computing organizations, libraries, faculty development centers, distance education/continuing education offices, and academic unit-based centers. This also results in a diffusion of leadership for academic technology creating major challenges (Albright & Nworie, 2008, pp.15-16).

Integration emphasizes the shared responsibility for providing a variety of support elements to the faculty, helping instructors function in a technological environment for reinforcing learning. Diaz (2010) describes the importance of more recent organizational structures that integrate IT, faculty development, the library, and campus support services.

Another example of effective solutions described in Chapter I involves how the faculty community can "help itself" or build ways to bootstrap into building expertise. Here, early adopters share processes with colleagues. Afterwards more faculty members have ideas about to approach technical support with in a specific task.

As described in the Results chapter, if faculty are able to demo their uses of

technology, this could lighten the load of technical staff and free them to tackle more complex support requests. While there is a proliferation of tools available, faculty members often lack concrete examples used in their discipline. Examples are needed such as pedagogically enhancing the teaching experience to enable students to learn better or faster, increased efficiency securing time for research and professional development, coordinating and enhancing resource utilization, and providing students a customized or unique learning experience (WASC, 1999).

Social Computing implications. Due to highlighting the prominence of Social Media and Networking it was suggested that Social Computing be brought up one level in the logic model to be beside Multimedia instead of a sub node, to serve as a node under Productivity/Content Creation/Research Tools. Referring to Table 4 for AAA and Table 9 for COE, many faculty use Facebook, Social bookmarking, crowdsourcing and Twitter. There are six out of nine AAA faculty who indicated that they use some form of Social Computing. AAA2 uses Social bookmarking as an assignment. They have students use Diigo, a tool to bookmark by tagging various sites to share the collection amongst the class.

There are four out of nine COE faculty who indicated that they use some form of Social Computing. COE1 uses Facebook for recruitment purposes. They have a Facebook site up for the departmental program in order to attract potential students for increasing enrollment. Because many individuals are on Facebook they may come across this program more readily.

Chapter I describes various applications of Social Computing and Multimedia. Whereas Multimedia itself is utilization of tools that are dynamic not static. This

component needs to be at a level of its own, not under Multimedia. The two are not entirely related to have a sub node association, but the relationship is better captured as an adjacent one.

Research Question 4: What are the problems and gaps involved in the utilization of educational technology services for these two organizations?

Tech savvy instructors also known as early adopters like to try new things out and also can test the limits of the infrastructure of the college and therein advocate for progress within the institution. Less advanced users often utilize the existing technology and often are either more content with the tools available or less willing to venture into unknown territory, while at the same time requiring often more support for what they do use. Often with less knowledge, they may not really know what they don't know. Therefore as shown in the AAA context in particular, underutilization may result when it comes to the possibilities of educational technology for the more typical or less active user of educational technology. COE showed more consistency in rates of at least minimal usage, although expressions of depth of use tended to be stronger in the early adopter patterns.

Funding is a major issue along with a potential lack of leadership. At some universities, the resources may not be distributed well in the university because of services are decentralized or unplanned. As reported here, this can lead to faculty who believe they don't have equitable access to services. If planning and policies are not updated or priorities are not considered, programs may not be in place in many cases to support use.

Many academic units such as described here may be planning much of their technology infrastructure and academic support in silos. Even for individual faculty

members or programs, some entitlements may be in place that create disparities within departments, colleges or schools, as described in Chapter I.

Needless to say, even with faculty-collaborative support approaches such as described above, in order to have more opportunities for outreach there likely need to be more support staff than the ratios reported in the data collected here indicate. The number of minutes of faculty support available to each faculty member is severely limited at these ratios, as evidenced by faculty reporting the limited access they feel they have to meet support needs. This would need to be more specifically explored with more extensive and accurate data sets; however, assuming ratios of even approximately 40:1 (faculty:IT support) and half of this time used by IT staff for support or planning not specifically related to an individual faculty member, at best this would indicate only about two hours per month of IT support available to each faculty member. Resolving a single Blackboard LMS issue, planning the context for a single distance learning class, or implementing a single new feature on a Word Press website or blog analytics can easily require two or more hours of interaction, once the trail of emails and contact time is toted up. Therefore, a month's allocation is rapidly expended, especially where services are not systematically implemented, interaction is required to achieve basic goals, reliability is lacking, or absence of clarity exists in how to obtain the services.

Limitations of the Study

My study has limitations due to the nature of the methods and to the questions that are being asked. First, the sample size is small. Increasing the number of interviews would have made it more possible to have representation from faculty who are likely to employ the most SAC IT (early adopters) but also would have allowed interviewing an

equal number of late adopters, which was not possible in this case. Having a larger sample could have added to my findings and strengthened the analysis, but is time prohibitive in the in-depth interviewing methodology.

Also reporting more detail instead of yes and no in the tables listed in Chapter III would have shed more light to specific uses, instead of the limited information of whether a faculty member used or did not use a particular tool. Although this more extended detail is captured in many of the tables and figures, it does not appear in the logic model display itself. Therefore via the data reduction phase of my analysis it would strengthen my findings for future research to consider reporting the intensity and/or types of use for the differences that exist between faculty and colleges, in the actual logic model, and perhaps also accounting for this with some form of weighting in the associated frequencies and percentages reported

Interviewing the IT Staff in the case study units more in-depth as was done with the faculty members would have given me better access to resources that would enhance my evaluation. Having access to more detailed information for each unit as well as each academic department and program within the unit might allow for additional depth of analysis. In most cases the written documentation of services was so sparse and responses by email correspondence so limited that more in-depth interviews of the IT staff seem necessary.

Acquiring records of consultations, trainings and workshops from the IT staff where statistics and user response processes were collected would have been very useful, as a survey design type of approach to data collection. This data could have added

contrast about what is available to faculty, and could provide an additional data stream for future research.

Of course, data from other units at this university, as well as data from other universities, would significantly broaden the investigation, and allow more contexts to consider whether a logic model approach to evaluation such as the SAC model would be helpful.

Implications for Future Work

Implications for future work include addressing some of the limitations above. Additionally, it would be of value to know how or whether such a baseline model as SAC can be expected to evolve effectively over time if implemented for evaluation. For instance, would use and perceptions improve as IT staff specifically worked with faculty around the themes described in the Results chapter? Would leadership become more informed about what faculty need, and would this change or realign resources in profitable ways? Furthermore, would the model prove extensible as new technologies arise in this fast moving arena of educational technology and academic support?

Referring to the node A1. Productivity/Content Creation/Research Tools under the SAC model, research was likely under emphasized in the evaluation interview protocol. The recommendation here is to either ramp up the data solicitation regarding research uses when interviewing according to the SAC model, or to consider that only the portion of academic computing specifically related to instruction is well covered.

As part of my interview protocol, research should have been an element of inquiry emphasized ore in order to gather more information. I was interviewing faculty at a research university rather than at community college or at another post-secondary

institution with less of a research-oriented mission. I realized upon examining the data from the interviews that my questions had solicited faculty focus, however, more on their instructional work as compared to the academic support needs of their research work . More interesting data could be extrapolated based on which components are in use more in instruction versus research per college.

The current work focused on interviews of some faculty members regarding academic support aligned with the SAC model. Other audiences and stakeholders are outside of the scope of this dissertation but are also very important, such as students and staff. For students, future work in this area could include using a minimal logic model to assess how students are affected by the use of technology in their classrooms or lack thereof, and also if these technologies assist in knowledge acquisition. Interviewing other stakeholders such as non-IT staff may also offer more concrete information about the academic computing infrastructure, for instance regarding how distance learning class arrangements are made or whether there are barriers in communicating to faculty about the resources available to them.

Use of the SAC model. As described in Chapter I, the needs for academic technology support have been changing quickly in higher education. One response to the changing needs is to establish some additional tools for how to evaluate programs. This can help to provide information about important services that are present or missing, and serve as a basis for discussion in prioritizing directions for academic support at an institution.

The SAC logic model used here suggests that one mode of evaluation could be to identify an array of basic or representative services or components that should be in place

at a particular campus or in a particular unit, and then to evaluate the usage and perceptions surrounding the components, such as through an interview or survey design. Such a logic model seems extensible because new components can readily be added, and technologies removed or updated that become obsolete. It also provides readily accessible displays and low-threshold tools for communication and comparison purposes of services and use, while encapsulating an evidence-based focal point for discourse as shown here.

Used here, the SAC model indicated a great deal of robust similarity between the two units studied, as shown in the discussion of themes in Chapter III. At the same time, the models helps to point out some differences that may be appropriately mission related to academic units, such as more multimedia in the architecture and arts school, and more shared wiki knowledge database use in the education school.

Using the SAC model to collect interview data also indicated some differences between the units studied that seems less mission driven and more about logistics, history or organization of the structure of the units. For instance, concerns about the communication about services, accessibility and equity of resources was identified in the less centralized unit, while the more centralized unit described beliefs among the faculty that the infrastructure was strongly limited relative to the unit's overall mission. The unit less directly focused on educational research seemed to show considerably more variance in at least minimal technology adoption patterns for the faculty members interviewed, while the unit focused on educational research as the domain showed apparently more consistency in at least minimal or reported use across the faculty interviewed.

It also became clear that at least for these two units, the SAC model would need to be extended to include distance learning, lecture capture and collaborative meeting

technologies that support remote sites as a key component of the instructional needs driving the faculty use of technology. So while the SAC model is intended to be a minimum base case for an evaluation tool, it is likely necessary to supply some additional logic case modules that could be appended as necessary for an evaluation, such as here for these three distance affordances in both units.

For an evaluation context, modules that could be added to SAC might be selected by the leadership team organizing the evaluation, based on the evaluation questions to be asked, along with the common “minimal” base case as described in Figure 6. These modules could also be added to create a “robust” model, as discussed in Chapter I, in addition to a base model.

These extension modules could add to the logic framework but could also include a fuller look at professional development for faculty members, if that were desired. Although this was out of the scope of this dissertation so not fully discussed here, the need for more professional development was described in several of the interviews. For example there was a question about where MOOCs would fall under the model. MOOC stands for Massive Open Online Course, this is a movement similar to the Open Content one as described in Chapter I. Given that the design and concept as concerns the information technology support needs is similar to LMS/CMSs, combined with Social Computing and some aspects, I would place that in SAC Model under A2 but might need some internal referencing showing where parts of the model interact with each other. Interesting for the University of Oregon context used here in the case studies, MOOCs have yet little penetration and did not specifically arise in the interview data set collected. Obaverse was used by three COE faculty as a Learning Management System in

connection to Blackboard. But Obaverse would be considered more of an Open Learning Management System. Therefore MOOCs did not fall within the scope of my research findings specifically, but may be noted as potentially an emerging part of the model in other contexts.

In order to observe cross-disciplinary programs within various departments it was brought to my attention that Programs and Programming also need to be added as part of the Academic Computing logic model. There are various applications for computing using programming languages for instance to run statistical models. Many departments such as Computer and Information Science, Linguistics, Economics, and Physics use coding to create animations, for data retrieval and analysis, and engineering computations. Based on the original SAC Model Programs and Programming would fall under A1. Productivity/Content Creation/Research Tools as A1e when referring to Figure 6.

Of course, limitations for the use of SAC are many and include the interview sample size, the cross-case analysis of only two cases, the situation of the data collection at a single university, and the limits of both self-report data and college-level administrative data collection as a source in the early steps of the evaluation.

Overall, the program evaluation conducted through the SAC model did seem to provide utility in validating the use of the model for the base case. All components of the model had multiple interview respondents at each of the units responding as including the component in their educational practices. Many of the components showed the majority of the respondents engaged in some degree of use.

Furthermore, faculty interview participants seemed eager to discuss their academic technology experiences and behaviors when presented with the organization of the SAC model. Engagement of faculty is key in academic support planning as described in Chapter I. The support questions of the semi-structured interview seemed to provide useful trend information to help understand the SAC model findings. If mechanisms by which engagement can be fostered include such data-centered practices as logic models, evaluation techniques and data displays, the investment might be warranted additionally on the basis of improving the outcomes of spending for what is necessarily becoming a fast-growing expenditure in higher education.

Overall, this research suggests at least at small scale and in the two-case context that such models and approaches may serve useful in the IT campus community, both as a baseline for considering academic support and potentially as a scalable tool for the adoption of an evaluation framework for improving academic support in higher education.

REFERENCES CITED

- Albright, M.J & Nworie, J. (2008). Rethinking academic technology leadership in an era of change. *EDUCAUSE Quarterly*, 31(1), 14-23.
- Albright, M., & Nworie, J. (2007). Professional preparation of academic technology leaders for higher education. *International Journal of Instructional Media*, 34(1), 61-71.
- Anderson, J. A. (1996). *Communication theory: Epistemological foundations*. New York: Guilford.
- Baker Stein, M (February 10, 2014) Ready or Not, Change is Coming [Daily article] Retrieved from <http://www.insidehighered.com/blogs/higher-ed-beta/ready-or-not-change-coming>
- Bender, B., (May 27, 2003). Student-Centered Learning: A Personal Journal. *ECAR Research Bulletin*.11, 12.
- Blatecky, A. West, A. & Spada, M. (2002). Middleware: the new frontier. *EDUCAUSE Review*, 37(4). 24-35.
- CAST. (2013). About UDL. Retrieved June 30 2014, from <http://www.cast.org/udl/>
- Chester, T. (2006). A roadmap for IT leadership and the next ten years. *EDUCAUSE Quarterly*, 29(2), 56-60.
- Crawford, G., Rudy, J. A. and the EDUCAUSE Current Issues Committee, (2003). Fourth Annual EDUCAUSE Survey Identifies Current IT Issues. *Educause Quarterly*, 26. 2, 12-26.
- Crawford, M. (October 01, 2002). Enhancing School Leadership: Evaluating the Use of Virtual Learning Communities. *Educational Management & Administration*, 30, 4, 431-45.
- Crawford, C. M., & Willis, J. (2002). *Can Standards Be Met and Evaluated through an Online Teacher Education Technology Course? A Case Study*.
- Crawford, C. M., & Gannon-Cook, R. (2002). *Faculty Attitudes Towards Distance Education: Enhancing the Support and Rewards System for Innovative Integration of Technology Within Coursework*.
- Crews, T.B, Miller, J.L, & Brown, C. M (2009). Assessing faculty's technology needs. *EDUCAUSE Quarterly*, 32(4). Retrieved January 20, 2010, from <http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/AssessingFacultyTechnologyNee/192969>

- Dede, C. (October 01, 2007). Reinventing the Role of Information and Communications Technologies in Education. *Yearbook of the National Society for the Study of Education*, 106, 2, 11-38.
- Denzin, N. K. (2003) *Collecting and interpreting qualitative materials*. Sage
- Diaz, V. (2010) Teaching and learning in review: Insights from the EDUCAUSE 2010 annual conference. *EDUCAUSE Quarterly*, 32(4). Retrieved March 22, 2012, from <http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/TeachingandLearninginReviewIns/219115>
- Dick, W., & Carey, L. (1996). *The systematic design of instruction*. New York, NY: HarperCollins College Publishers.
- Donnelly, R., Harvey, J., & O'Rourke, K. C. (2010). *Critical design and effective tools for e-learning in higher education: Theory into practice*. Hershey, PA: Information Science Reference.
- Downes, S (2005) Semantic Networks and Social Networks, *Learning Organization*, 12, 5, 411-417.
- Edelson, D. C., Pea, R. D., & Gomez. L. (1996). Constructivism in the collaboratory. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in educational technology*. Englewood Cliffs, NJ: Educational Technology Publications.
- Edwards, E., Wiley, D., & Nelson, L. M. (January 01, 2002). Foundations of a New Instructional Paradigm... Really!. *Tech Trends Washington Dc-*, 46, 16-20.
- Ehrlich, D. (2002). Glossary of terms from HRD 408: instructional design II. Retrieved March 17, 2009, from <http://www.neiu.edu/~dbehrlic/hrd408/glossary.htm>
 ELI 7 Things You Should Know About Data Visualization II (August 2009) Retrieved September, 2009, from <http://net.educause.edu/ir/library/pdf/ELI7052.pdf>, EDUCAUSE
- Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An introduction*. Boston: Allyn and Bacon.
- Gallagher, S., (May 13, 2003). The New Landscape for Course Management Systems. *ECAR Research Bulletin*. 11, 10.
- Greene, J. G. (2005). *Stakeholder involvement*. *Encyclopedia of evaluation*. Thousand Oaks, CA: Sage. Retrieved June 5, 2009, from http://0-sage-reference.com.janus.uoregon.edu/evaluation/Article_n520.html

- Greene, J. G. (1987). Stakeholder participation and utilization in program evaluation. *Evaluation Review*, 12(2), 91–116.
- Gugiu, P. C & Rodríguez-Campos, L. (2007, November). Semi-structured interview protocol for constructing logic models. *Evaluation and Program Planning*, 30(4), 339-350.
- Hacker, T. & Wheeler, B. (2007). Making research cyberinfrastructure a strategic choice. *EDUCAUSE Quarterly*, 30(1), 21-29.
- Hatry, H. P., United Way of America., & United Way of America. (1996). *Measuring program outcomes: A practical approach*. Alexandria, Va. (701 N. Fairfax St., Alexandria, Va. 22314-2045: United Way of America.
- Herro, S. (1999), “The impact on user services of merging academic libraries and computing services”, available at: www.educause.edu/ir/library/pdf/CSD1193.pdf
- Hsu, J. (2009). Employing interactive technologies for education and learning: Learning-oriented applications of blogs, wikis, podcasts and more . . . In Tomei, L. A. (Ed.), *Information communication technologies for enhanced education and learning: Advanced applications and developments* (pp.234 –258). Hershey: Information Science Reference.
- Hui, D. (2009). Understanding the effectiveness of collaborative activity in online professional development with innovative educators through intersubjectivity. In Tomei, L. A. (Ed.), *Information communication technologies for enhanced education and learning: Advanced applications and developments* (pp.283-302). Hershey: Information Science Reference.
- ITAA. (2007). Definitions of information technology. Retrieved March 3 2008, from <http://www.ita.org/es/docs/Information%20Technology%20Definitions.pdf>
- Ip, A., Morrison, I.& Currie, M. (2001) What is a learning object, technically? In WebNet World Conference on the WWW and Internet Proceedings (Orlando, FL, October 23-27, 2001)
- Izzo, M. V., Hertzfeld, J. E., & Aaron, J. H. (December 07, 2001). Raising the Bar: Student Self-Determination + Good Teaching = Success. *Journal for Vocational Special Needs Education*, 24, 1, 26-36.
- Izzo, M. V., Murray, A., & Novak, J. (January 01, 2008). The Faculty Perspective on Universal Design for Learning. *Journal of Postsecondary Education and Disability*, 21, 2, 60-72.
- Katz, R. (2002). The ICT infrastructure: a driver of change. *EDUCAUSE Quarterly*, 37(4), 50-61.

- Kloper, E., & Squire, K. (in press). Environmental detectives: The development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development*
- Klopfer, E., Yoon, S., & Rivas, L. (2004). Comparative analysis of Palm and wearable computers for participatory simulations. *Journal of Computer Assisted Learning*, 20, 347–359.
- Kramer, M., & Maughan, G. R. (2001). *Technology leadership Communication and information systems in higher education*. New Directions for Higher Education, no. 115. San Francisco: Jossey-Bass.
- Lamberson, M., & Lamb, B. (2003). *Course management systems: Trapped content silos or sharing platforms?* The Ohio State University. Retrieved August 15, 2010 from http://telresearch.osu.edu/learning_objects/documents/TELR-LO7screen.pdf
- Lan, Y., Sung, Y., Chang, K. (2007, October). A mobile-device-supported peer-assisted learning system for collaborative early EFL reading. *Language Learning and Technology*. Retrieved November 1st, 2007 from <http://lt.msu.edu/vol11num3/lansungchang/>
- Lightfoot, E. & Ihrig, W. (2002). The next-generation infrastructure. *EDUCAUSE Review*, 37(6). 52-61.
- Lindberg, J. O., & Olofsson, A. D. (2010). *Online learning communities and teacher professional development: Methods for improved education delivery*. Hershey, PA: Information Science Reference.
- Locatis, C., & Al-Nuaim, H. (January 01, 1999). Interactive Technology and Authoring Tools: A Historical Review and Analysis. *Educational Technology Research and Development*, 47, 3, 63-76.
- Magoulas, G. D. (2011). *E-infrastructures and technologies for lifelong learning: Next generation environments*. Hershey PA: Information Science
- McElroy, P. & Beckerman, B. (2003) *Managing web-based digital learning content in higher education institutions*. Learning Content Exchange, Inc.
- Meng, P. (March 2005) *Podcasting & vodcasting: Definitions, Discussions & Implications*. White Paper, University of Missouri
- Miles, B.M & Huberman, A. M. (Eds.), (1994). *Qualitative data analysis: an expanded Sourcebook*. 2nd. Ed. Thousand Oaks: Sage Publications.

- Office of Institutional Research. (2014, May, 13). [website for University of Oregon Profile - Employees by Type and Area] Retrieved from http://ir.uoregon.edu/sites/ir.uoregon.edu/files/2012_21_Empls%20by%20Cat.pdf
- Patton, M. Q. (1997). *Utilization focused evaluation: The new century text*. 3rd. Ed. Beverly Hills, CA: Sage Publications.
- Pear, J. J., & Crone-Todd, D. E. (2001). A social constructivist approach to computer-mediated instruction. *Computers & Education*, 38(1), 221-231.
- Radenski, A. (2009). Expanding computing as an academic service discipline. *Computer*, 42(6), 101-104.
- Rheingold, H. (2002). *Smart mobs: The next social revolution*. Cambridge, MA: Perseus Pub.
- Scottish Colleges and the Provision of Learning for the Digital Generation: An Analysis of Staff Capabilities and Training Needs (2007) JISC Regional Support Centres, ETNA, III, Scotland.
- Seidel, R. J., Chatelier, P. R., NATO Defense Research Group., & NATO Defense Research Group. (1994). *Learning without boundaries: Technology to support distance/distributed learning*. New York: Plenum Press.
- Sharp, Sean. (2014, May, 15). Re: quick question. [Electronic mail].
- Sullivan, Gary. (2013a, October, 11). Re: information needed [Electronic mail].
- Sullivan, Gary. (2013b, October, 11). A&AA technology services. [Department help website]. Retrieved from <http://aaatech.uoregon.edu/>
- Tanguma, J., Martin, S. S., & Crawford, C. M. (2002). *Higher Education and Technology Integration into the Learning Environment: Results of a Survey of Teacher Preparation Faculty*.
- The Horizon Report (2010, January) (ID: CSD5810) New Media Consortium (NMC) Retrieved from the EDUCAUSE Learning Initiative (ELI) website: <http://www.educause.edu/ELI/2010HorizonReport/195400>
- The Horizon Report (2008, January) (ID: CSD5320) New Media Consortium (NMC) Retrieved from the EDUCAUSE Learning Initiative (ELI) website: <http://www.educause.edu/ELI/2008HorizonReport/162471>
- The Horizon Report (2006, January) (ID: CSD4387) New Media Consortium (NMC) Retrieved from the EDUCAUSE Learning Initiative (ELI) website: <http://www.educause.edu/ELI/2006HorizonReport/154127>

- Tomei, L. A. (2008). *Encyclopedia of information technology curriculum integration: 1*. Hershey [u.a.: Information Science Reference.
- Tomei, L. A. (2008). *Encyclopedia of information technology curriculum integration: 2*. Hershey [u.a.: Information Science Reference.
- Vaughan, J. (2004). Policies governing use of computing technology in academic libraries. *Information Technology & Libraries*, 23(4), 153-167.
- Venegas-Rogers, Daisey. (2014, May 15). Re: up-to-date data request [Electronic mail].
- Wada, K, & King, P. (2001). IT policy: an essential element of IT infrastructure. *EDUCAUSE Review*, 36(3), 14-15.
- WASC (2000). ITS' mission 2000 self-study - WASC accreditation - Cal Poly State University, CA, Retrieved May 6 2012, from <http://wasc.calpoly.edu/2000/current/itsmission.htm>
- WASC (1999). Technology survey results - Cal Poly State University, San Luis Obispo, CA, Retrieved May 8 2012, from <http://www.wasc.calpoly.edu/2000/innovative/reports/technology/technology.htm>
1
- Webb, K. A. (2005) Aligning policy and practice: Information and instructional technology planning in the university of Georgia (Dissertation) University of Georgia, Athens Georgia.
- Weston, T. (January 01, 2004). Formative Evaluation for Implementation: Evaluating Educational Technology Applications and Lessons. *American Journal of Evaluation*, 25, 1, 51-64.
- Wierschem, D & Ginther, D. (2002). Acquisition and replacement of technology hardware in higher education. *EDUCAUSE Quarterly*, 25(3), 52-57.
- Wiley, D. (January 01, 2003). The Back Burner - Baklava or raw onions? Using layers to untangle the difference between instructional media and instructional strategies. *Techtrends : for Leaders in Education & Training*, 47, 1, 72.
- Wiley, D. A. (2003). *Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy*. S.l.: s.n..
- Wiley, D. A., & Agency for Instructional Technology. (2002). *The instructional use of learning objects*. Bloomington, Ind: Agency for Instructional Technology.
- Woodbury, Jeffrey (2014, May, 15). Re: quick question. [Electronic mail].

Woodbury, Jeffrey (2013a, October, 28). Home page college of education.
[Department website]. Retrieved from <https://education.uoregon.edu/>

Woodbury, Jeffrey (2013b, October, 28). College of education: blogs.
[Department blog]. Retrieved from <https://coe.uoregon.edu/>

Woodbury, Jeffrey (2013c, October, 28). College of education tech help. [Department
help website]. Retrieved from <http://coehelp.uoregon.edu>