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ABSTRACT

Technology plays an important role in the everyday life of children born in the 'digital' era. The ability to use web technologies in the K-6 educational context opens up new opportunities for teaching and learning. This study investigates the adoption and integration of a web technology into a second grade classroom. The study utilizes a community-based research method to assess the technology adoption decision and the skills, knowledge, and resources needed to effectively utilize this digital medium in the classroom and beyond. The study's context is a collaborative effort between the academic researchers and an elementary school teacher to develop and implement a classroom web site. This project is a pilot to the school-wide implementation of web sites in grades K-6. Our findings suggest that the factors for web site adoption and integration include the alignment of the site's purpose with the teacher's needs, the use of rapid application development strategy for web design, the development of a comprehensive teacher's training program for web content management, and the use of collaborative tactics for web site implementation. Web technologies have a potential to enrich the students' educational experience and home-to-school communication. However, there are social and technological challenges for planning, designing, and diffusing web technologies into the elementary schools. The findings of this study have implications for the elementary school educators interested in developing and integrating classroom web sites for teaching, learning, and communicating with their community.

KEYWORDS

Community-based research, web technologies, elementary school education, software development strategies

INTRODUCTION

In the effort to increase student achievement and education quality and as a result of government initiatives, K-6 schools invest in information and communication technologies. The adoption of these technologies varies across classrooms. The most common uses, however, are word processing and on-line educational games (Cesarone, 2003). Web and communication-based technologies are not prevalent in the K-6 educational level. Potential benefits of adopting these technologies are enhancing parent-teacher communication, promoting parents involvement, and supporting academic activities. Consequently, elementary schools are initiating projects to develop web sites for their teachers.

Service-learning (S-L) projects with universities are one alternative to develop web sites for teachers at low cost. The S-L projects have a positive impact on student learning outcomes (Guthrie and Navarrete, 2004). However, once the web sites for teachers are developed, there are several factors that limit their adoption and integration in elementary schools. The case study presented in this paper sheds light on the factors that influence the adoption and integration of web technologies in K-6 education. The study's findings were derived through an innovative approach of community-based research (CBR).

CBR is a research method where the researcher and a community member work together to solve a problem that will have an impact on the community. This research strategy is similar to action research, where the researcher actively participates in the

solution of a given problem, in addition to reporting the findings (Gummesson, 2000). In this study, the researcher (project manager), a student assistant (designer), and an elementary school teacher (client) collaboratively worked together on designing and implementing a web site for a second grade classroom.

The main findings of this study are that CBR can be used to increase the adoption and integration of web technologies. Through collaboration, the team discovered the ways in which the client wanted to use the web site, the content to be included on the site, and the structural navigation of the site. Another factor affecting the adoption is the software used to develop the site. The study shows that one successful strategy is to develop the site with a web authoring tool (e.g. *Dreamweaver*), but manage the site's content with a less complex tool (e.g. *Contribute 3.0*). Moreover, a training program should be adopted to secure the use of the site over time. Finally, the factors for the site's long-term sustainability must include proper technical and human infrastructures.

BACKGROUND

Service-Learning experiences are becoming more frequent in higher education. Web design projects for community partners are an important part of the S-L program at Cal Poly Pomona. S-L promotes projects for graduate and undergraduate courses, where students develop a solution to a community partner problem, while they learn the objectives of the course (Bringle and Hatcher, 1996). Other authors define S-L programs as educational experiences promoted by faculty and a community entity that act as client/sponsor. The service provided under the program enhances student learning, and the student course learning enhances the service provided (Furco, 1996.) S-L is a sound strategy to teach web design courses (Lazar and Lidke, 2002; Guthrie and Navarrete, 2004). The experience at Cal Poly Pomona shows positive impact of S-L on students' learning outcomes. Unfortunately, the impact on the elementary schools has not been as expected. After the web sites were implemented, their content was soon obsolete because the teachers failed to maintain them. Consequently, the sites were rarely integrated into the elementary school classrooms. CIS students used prototyping strategies to develop the web pages for the S-L program. In ten weeks each student identified the web site requirements, developed a prototype, got feedback from the teacher on the content and functionality of the site, improved the prototype, conducted training sessions to update and modify the site, and published the site. This development strategy has been successful in developing the web sites, but it has failed to secure the future use of the sites in three elementary schools.

Several factors limit the adoption of web technologies in elementary schools. One strong limitation is the web site authoring tool. In different projects, the S-L program has used three different tools -- HTML, Dreamweaver, and FrontPage -- to develop the sites. In each of the three cases, the tool was too complex for the teachers to use in maintaining their sites. Without proper maintenance and updates, the use of the sites decreased, resulting in the low probability of integrating web technologies into the classroom activities.

The growing use of Internet and the fierce competition faced by e-businesses has promoted research to identify characteristics of successful sites and the ingredients of effective development of web technologies. Savin and Silberg (2000) point out that successful web site development include: planning the site, strategic thinking, targeted marketing, and state-of-the art technology. Similarly, Rabin (2001) identifies the following characteristics for high-performance sites: understanding customer behavior, determining site performance goals, and planning the infrastructure. Martin (1991) suggests that Rapid Application Development (RAD) methodology, comprised of Joint Application Design (JAD) and Evolutionary Prototyping (EP), is an effective development strategy for projects with low structure, poorly understood requirements, and schedule constraints. Active end-user participation during JAD and EP sessions can produce significant impacts in productivity (Vosburgh, 1981). User involvement in the development process can also mitigate project risks, help avoid rework, and enhance user's satisfaction with the system being developed (McConnell, 1996). Furthermore, having an internal change agent as an intermediary between the technical personnel and the users is an effective way to introduce new technology (Brancheau and Wetherbe, 1994). These recommendations match Walton's (1989) research on the ingredients for effective IT implementation. Walton proposes that successful technology implementations are structured into three phases: generating the context for the system, designing the system, and putting the system into practice. Each phase should incorporate the ingredients of alignment, organizational commitment / system ownership, and competence mastery. Walton concludes that effective IT implementations require generating the context for the system before designing it, designing the system to tap user ownership and promote IT literacy, and ensuring operational alignment, ownership and mastery of the system once it is implemented.

Cal Poly Pomona University started a service-learning program with students of interactive web design. Thirty six web sites for school teachers have been developed, with an impressive impact on the university students' learning (Guthrie and

Navarrete, 2004). However, the impact on the schools and school teachers has been minimal. After the implementation and training programs, many web sites were never published on the school web site. Our conclusion is that there are several factors that inhibit the use and maintenance of the web site by the teachers.

RESEARCH QUESTIONS AND METHODOLOGY

The objective of this study was to gain a better understanding of the factors that influence the adoption and integration of web technologies in the elementary school setting. The study also aimed to discover the ways in which the community-based research (CBR) facilitates technology adoption and integration decisions. The research questions for the study were as follows:

- What factors influence the adoption decisions and the integration of web technologies in K-6 education?

- How does community-based research facilitate the adoption and integration of web technologies in the elementary school context?

We utilized the CBR methodology to investigate the technology adoption/integration phenomenon as it unfolded in a real-life setting. CBR is an academic-community partnership in which the members of an academic institution engage in a collaborative research with the members of the community for the purpose of solving a pressing community problem (Strand, et al., 2003). CBR validates multiple sources of knowledge and encourages the use of multiple ways of discovery. The creation of knowledge that results from the collaborative inquiry is achieved *with* and *for* the community in the effort to address a community-identified need.

CBR differs from the traditional academic research in that its primary goal is to fulfill an urgent need of a community as opposed to simply advancing the knowledge within a given discipline. CBR is similar to action research, yet there are also notable differences. The aims of CBR and action research are of the interpretation of a socially constructed phenomenon in which the researchers seek to generate organizational change and, at the same time, study the change process. However, in CBR both the trained researcher *and* the community member design and conduct research. This collaborative endeavor instigates social change while at the same time provides an opportunity for the research team to study the impacts of that change on the community partner.

We choose the CBR method for this study because the primary goals of our research were to affect a social change in the use of web technologies in elementary education and to assess that change. The process of social change was conceived and implemented through the collaborative efforts of an academic researcher, a Cal Poly student, and an elementary school teacher. Each person brought their unique expertise to the project – from project management skills of the researcher and technical skills of the designer to the teaching experience of the client. Yet, in spite of their different expertise, all three acted as collaborators, researchers, and learners as they planned, designed, trained and integrated a web technology into a second grade classroom.

CASE STUDY BACKGROUND

The web site development project was undertaken at the Chaparral Elementary School (CES). CES is one of the seven elementary schools in the Claremont Unified School District (CUSD). CUSD, a Los Angeles County school district, enrolls over 6,300 students. The district has an Educational Technology Master Plan (ETMP, 2003) which guides its use of IT for teaching and learning. However, recent budget cuts in K-12 education made it difficult for the district to upgrade its aging technology infrastructure and to integrate technology into the K-6 curriculum.

CES is a California Distinguished School that serves over 650 children with 30 teachers. Each classroom is equipped with a computer connected to the district's network. The selected classroom for our study was Room 6, a second-grade classroom at CES. The teacher of Room 6 has worked at CES for the past twenty years. Her students are exposed to computers once a week for half an hour as they work on their keyboarding skills and concept building activities. While Room 6 has a classroom computer, the teacher rarely utilizes it as a teaching/learning tool. She uses it primarily for word processing and e-mail tasks. A recent survey of her technology skills suggests that her technical proficiency is at the introductory level.

The web site project for the second-grade class at CES was a collaborative effort between a second-grade teacher (the client), a university student (the designer), and an academic researcher (project manager). This project was a pre-cursor to future service-learning web development projects at CES. Figure 1 shows the Home Page of the Room 6 Website.

Figure 1. Home Page of Room 6 Web Site

CASE ANALYSIS

The collaborative process by which the second grade web site evolved was comprised of four phases: 1) planning the project, 2) designing the web site, 3) training the client to maintain the site, and 4) integrating the site into the second grade class. Table 1 presents the questions that guided our investigation and the main findings for each phase. During the planning phase, the alignment of the project goals with the web site's purpose and the target audience, as well as the choice of the web site development / maintenance platforms, were among the key factors facilitating the web site adoption and integration decisions. The essential factors identified during the design phase were the collaborative research combined with the evolutionary prototyping (EP) and joint application development (JAD) to evolve the requirements for the web site. The integration of EP, JAD and collaborative research enabled the alignment of the site's content and user interface with the client's evolving requirements and expectations for the site. During the training phase, the key factor for web site adoption was a comprehensive training program aimed at increasing the client's efficacy in maintaining her site once it was implemented. Finally, the collaborative effort to implement, diffuse and assess the site's sustainability requirements were additional factors influencing the adoption and integration of the second grade web site at CES.

Phase 1 – Planning the Web Site Project

The objectives of the planning phase were to identify web site purpose / target audience and to select the software platforms for web design and web site maintenance. The main goal of the project was to address the need of a non-technical client to bridge the technology gap between her and her students. The vehicle for bridging that gap was a classroom web site. Given the increased importance of the technology literacy skills in elementary education and the lack of the school district's support to help teachers integrate web technologies into their classrooms, there was a need for an academic-community partnership to help address this problem.

Phase	Question	Web Site Adoption and Integration Factors
Planning	• What is the purpose of the web site and who is the site's target audience?	• Alignment of the need for a web site with the site's purpose and the target audience
	• What software should be utilized for web design and web site maintenance?	• Alignment of software platform with the needs of the designer and the client
Design	• What is the appropriate lifecycle model for the web site development?	• Evolutionary prototyping and JAD combined with collaborative research
	• What is the purpose, content and user interface of the site?	• Alignment of the web site's content and user interface with the site's purpose
Training	• How should a non-technical client be trained to maintain the content of a web site?	• Training program to promote client's mastery in maintaining the site
Integration	• How should the web site be implemented?	• Collaborative implementation tactics
	• How should the web site be integrated into the second grade classroom?	• Collaborative, evolutionary integration tactics
	• What are the critical factors in sustaining the use of the site over time?	• Web site sustainability factors

Table 1. Project Phases and Findings

In reflecting on the project goals and benefits, the client commented: "I saw it as a win-win project in that I could get introduced to a technology that I was completely unfamiliar with, and, at the same time, create a vessel for communication with my families, students, and the community at large. Also, I could highlight what we are doing in elementary education now as well as make the public more aware of what is going on in the individual classroom". Structuring the project as a collaborative partnership improved the efficiency of the team's working relationships, provided progress visibility, secured the client's commitment to the project, and ultimately facilitated the adoption and integration of the web site.

Another factor that contributed to the web site adoption and integration was the choice of the software platform for web design and web content management. In the early phases of the project, the team made a decision to use *Dreamweaver* as a development platform for the web site. However, it was determined that *Dreamweaver* was not adequate for training a non-technical client to maintain her site. This decision was reinforced by the failure of the web projects at the Oakmont, Sycamore, and Sumner schools where the teachers were ill prepared to tackle the highly technical aspect of HTML, *Dreamweaver*, and *FrontPage*. Consequently, the training platform chosen by the team for this project was Macromedia's *Contribute* 3.0 software. While *Contribute* has a limited set of features to enable the full scale web development, its intuitive, word-processor like interface, makes it an ideal content management tool for users with minimum technical proficiency. The choice of *Contribute* as a platform for training had a positive impact on the web site adoption and integration because it promoted the competence and mastery of a technologically-challenged client in her quest to become self-sufficient in maintaining her web site.

The process of collaborative planning and community-based research encouraged the designer and the project manager to share their ideas and technical expertise with the client in the effort to educate her about the potential uses of web

technologies in elementary education. This newly acquired knowledge, combined with the mutual agreement on project goals and benefits set the stage for the eventual adoption and integration of the second grade web site.

Phase 2 – Designing the Classroom Web Site

The objective of the design phase was to gain an in-depth understanding of the client's requirements for the web site. The team utilized EP and JAD to evolve poorly understood requirements through a series of five iterative prototypes. Each successive prototype was developed based on the results of the teams' research and the client's evolving preferences for the content, navigation and the usability of the prototypes. A survey of 20 parents (70% response rate) provided additional feedback on the desired content for the site. 60% of the respondents wanted to see a calendar, a photo gallery, classroom news, and field trip information on the Room 6 website.

At the onset of the project, the client had only a vague idea about the purpose and the value-added of the web technology for her and her students. However, through the iterative prototypes and the JAD sessions, she came to realize that the web site could enable her to communicate electronically with students / parents and to help guide students through the digital age by exposing them to safe educational resources on the Internet. The client's evolving understanding of the purpose and value of a classroom web site had a significant impact on her decision to adopt and integrate this technology into her classroom. According to her: "This project made me question my own pedagogy – what I think is important to teach and what is important to communicate to the families.. It made me go back and look at my teaching skills, and the way that I may need to change my teaching skills to fit the new generation of learners…I came to realize how comfortable the new generation feels with computer technology and how important it is for us to address it as a teaching tool and not think it is just for games on the weekend – it needs to be a part of the daily teaching-learning experience".

The community-based research facilitated the integrative design by empowering the team to leverage each other's expertise, involving the client in the design process, and researching the design alternatives. Furthermore, it promoted a sense of ownership, and helped align the essential design characteristics with the site's purpose and value, thus influencing the extent to which the final product would be adopted by the client.

Phase 3 – Training the Client to Maintain the Site

Client mastery of new technology is an important ingredient in the effective implementation and use of that technology over time (Walton, 1989). In the planning phase of the project, training was identified as one of the critical activities because the client's technical proficiency was low. The training phase involved designing and fine-tuning the training materials, and conducting the training sessions with hands-on exercises that reinforced different aspects of web content management. As the training progressed, the client's newly acquired technical skills and knowledge not only enhanced her technical mastery, but, more importantly, boosted her confidence in her own abilities to manage the content of the site. Consequently, the training program had a positive impact on the web site adoption/integration because it prepared the client for the diffusion of a web technology once it was put into practice.

At the onset of the project, the team decided to use *Contribute* for training because its easy-to-use graphical interface was an ideal training platform for a technologically challenged client. During the training phase, the designer collaborated with the client on the development of training materials aimed at building the client's competency to maintain her site. The client commented: "I found it very interesting, and frustrated at times, to be trained on the use of this technology. I was surprised how much work it was to go through training and how difficult the training is for someone at my level of technical proficiency. It is like trying to learn the Hebrew language – it is going into a complete different paradigm".

Community-based research facilitated the adoption and integration of the web site because it addressed the needs of a technologically-challenged client to become self-sufficient in maintaining her site. The trial use of technology through focused training workshops reduced the uncertainty of the adoption decision. And the collaborative training provided a vehicle for the transfer of technical skills and knowledge from the designer to the client, thus enhancing the client's capacity to sustain her site over time.

Phase 4 – Integrating the Web Site into the Classroom

The objective of the integration phase was to implement and diffuse the web site into the second grade classroom. The implementation activities included setting up the web server account for the client and uploading the files to the server. The

collaborative implementation effort of this project stands in contrast to the implementations at Oakmont, Sycamore and Sumner schools. The gap in communication between the designers, the clients and the district's IT personnel had a negative impact on the success of the web projects at these schools.

Once the web site was implemented, the project manager worked closely with the client to evolve a set of integration tactics for diffusing the site into the weekly activities of the second grade class. Some of the integration tactics included the use of the site as a research tool for the report on classical composers, the in-class demonstrations of the site's resources for language arts and math concepts, and the use of the Helpful Links pages to help prepare students for standardized tests. The client said: "I will have children use the "Helpful Links" section of the site for some major projects, but I also see this site as a service to the families – sharing with the parents what is going on in the classroom and providing a safe environment to enrich the kids' experience with the Internet". Figure 2 shows a screen shot of the web site's Helpful Links Page. This page is utilized by Room 6 students to complete homework assignments and research reports. In addition to helping the client with the site's integration, the project manager continued the training program to help the client master the intricacies of the web site maintenance, thus increasing her capacity to maintain the site over time.
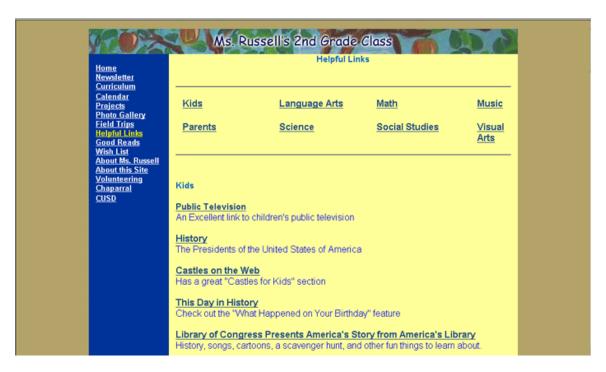

Figure 2. Helpful Links Page

The final step of the integration phase was to identify the critical factors for the site's long-term sustainability. These factors were as follows: 1) computing infrastructure with the Contribute software and Internet access, 2) a high quality projector for the structured lesson activities utilizing the class site, 3) a hot-line local technical support to assist with technology and web site maintenance problems, and 4) an on-going training program on the web content management. During the integration phase, the client commented: "Once this project is completed, it will be important to have someone on the other end of the phone line that could help me step through the maintenance on an as-needed basis, otherwise the web site could all too easily be abandoned".

The community-based research facilitated a smooth diffusion of the web technology into the second grade classroom and increased the likelihood of the site's long-term sustainability. In reflecting on the outcome of the project, the client remarked: "Was this project a success? Absolutely!!! It just keeps getting better and better, but that is due in great part because of the team's enormous commitment of time and energy to it. The biggest surprises of the project for me were to find out how little I knew, how much there was to learn, and how exciting the potential of this technology is for elementary education!"

DISCUSSION AND CONCLUSION

We set out to explore the factors that influence the adoption and integration of web-based technologies in the elementary school setting. We also aimed to discover the ways in which community-based research may facilitate the technology adoption and integration decisions. The empirical literature on IT implementations led us to expect that the ingredients for successful implementations include aligning the system with client needs, promoting client ownership and mastery, as well as having a change agent as an intermediary between the technologist and the client. Furthermore, the literature on web development pointed to the need for planning, strategic thinking, targeted marketing, and state-of-the art technology infrastructure. The patterns of our findings are consistent with the literature. Our findings suggest that project planning combined with a RAD strategy for web design, a training program for the teacher, and collaborative tactics for technology diffusion contributed to the adoption and integration of a 2nd grade web site at CES.

In the planning phase we found that it was important to determine the web site's purpose and to align the project goals with the needs of the client prior to commencing the design phase of the project.. We also found that the software choices for web design and site maintenance must be aligned with tasks as well the individual capabilities of the people who use them. Our findings suggest that this alignment is critical as evidenced by the failed web projects at three other elementary schools where the teachers were expected to master the highly complex features of HTML and web authoring tools. Finally, we found that CBR had a positive impact on the adoption of web technology because the internal change agent (project manager) facilitated the academic-community collaboration between the technical specialist (designer) and the elementary school teacher (the client).

One of the characteristics of our project was poorly understood requirements for the site's content and user interface. This was due to the client's unfamiliarity with web technologies and their potential as a vehicle for education and communication. Martin (1991) suggests that RAD is the best practice for eliciting requirements for projects with poorly understood requirements. Our JAD and EP sessions directly involved the client into the development process, thus ensuring that the final product meets her needs and expectations. Furthermore, Walton (1989) proposes that user commitment and ownership of the system are critical for effective technology implementation. Finally, Savin and Silberg (2000) point out that strategic thinking and targeted marketing are important characteristics of successful web developments. As we designed the second grade site, we found that integrating EP and JAD with collaborative research and feedback helped align the site's characteristics with the client's needs, technical capabilities and expectations for marketing and using the site. This alignment, in turn, garnered the client's commitment and ownership of the web technology and facilitated the adoption and integration decisions.

Walton (1989) further suggests that securing user mastery of the system is yet another key ingredient in the effective technology implementation. Our findings show that a comprehensive training program targeted at enhancing the IT skills of a non-technical client is critical to the acceptance and integration of new technology by the client. The training program developed in this project helped the client to begin acquiring the requisite tool kit for maintaining the content of her site once it was implemented. We also found that involving the client in the development of training materials helped customize the training program to the specific skills needed by the client to make her self-sufficient in maintaining the site.

Lastly, our findings suggest that the collaborative implementation and evolutionary diffusion tactics facilitate the adoption and integration of a new technology by a non-technical client. Literature suggests having the state-of-the-art technical infrastructure is a pre-condition to effective implementation and sustainability of web technologies (Rabin, 2001; Savin and Silberg, 2000). Our findings concur that a robust technology platform for web development and maintenance is important. However, we also found that another critical component to web site sustainability is a human infrastructure that provides an on-going training and hot-line support for non-technical clients as they continue experimenting and integrating web technologies into their classrooms.

The findings of this exploratory, community-based research have important implications for future research and practice. Theoretically, this study has prepared the groundwork for future qualitative research to replicate and extend the findings on the key ingredients for adoption and integration of web technologies in elementary schools. One of the limitations of our study is that we investigated the adoption/integration decisions by one rather than many K-6 teachers. Furthermore, since the web site for Room 6 was just implemented, we could not yet assess the long-term sustainability and impacts of the site on its target audience. Consequently, to straighten the validity and the theoretical generalizability of our findings, we propose to replicate the study on a larger scale through the web site development of fifteen classroom sites at CES. Furthermore, there is a need for future research to investigate the process of alignment between the web development tasks and user ownership and mastery of the system. Finally, the study highlights the enormous potential of community-based research as a vehicle for academic-community partnerships aimed at promoting social change and democratic participation in the change process.

REFERENCES

1. Brancheau, J and Wetherbe, J. (1994) Understanding innovation diffusion helps boost acceptance rates of new technology, in P. Gray, W. King, E. McLean, H. Watson (Eds.), MoIS: Management of Information Systems (2 ed.), The Dryden Press, Orlando, 198-209.

2. Bringle, R and Hatcher, J. (2004) Implementing service-learning in higher education, *Journal of Higher Education*, 67, 221-223.

3. Cesarone, B. (2003) Using technology in the classroom to foster student learning, *Childhood Education*, 79, 5, 329-331.

4. ETMP: Educational technology master plan. (2003) *Claremont Unified School District*. Retrieved on 2 Feb 2005 from http://chs.cusd.claremont.edu/tech/plan/CUSDEdTechPlan.pdf.

5. Furco, A. (1996) Service-Learning: a balanced approach to experiential education, in the Corporation for National Service's (Eds.) Expanding Boundaries: Service and Learning, p. 2-6.

6. Guthrie, R. and Navarrete, C. (2004) Service-learning impact on IS students in a web development course, *Information Systems Education Journal,* 2, 12, 2-11.

7. Gummesson, E. (2000) Qualitative methods in management research (2 ed.), Sage Publications, Thousand Oaks.

8. Lazar, J. and Lidke, D. (2002) Service-Learning Partnerships in the Information Systems Curriculum, in Lazar J. (Ed.), Managing IT/Community Partnerships in the 21st Century, 1–16.

9. Martin, J. (1991) Rapid application development. New York: Mcmillan.

10. McConnell, S. (1996) Rapid development, Microsoft Press, Redmond.

11. Rabin, S. (2001) Providing a high-performing commerce site, *Information Systems Management*, 18, 4, 40-51.

12. Savin, J. and Silberg, D. (2000) There's more to e-Business than point and click, *The Journal of Business Strategy*, 21, 5, 11-13.

13. Strand, K., Marullo, S., Cutforth, N., Stoecker, R., Donohue, P. (2003) Community-based research and higher education: principles and practices, Jossey-Bass, San Francisco.

14. Vosburgh, J. B. (1984) Productivity factors and programming environments, *Proceedings of the 7th International Conference on Software Engineering*, Los Alamitos, California: IEEE Computer Society, 143-152.

15. Walton, R. (1989) Up and running: integrating information technology and the organization, Harvard Business School Press, Boston.