

Community-Based, Educational Web Projects for the Arts: The Continuing Challenge of Meeting the Needs of Students, Clients, Subjects and Web Visitors

Bernard R. Robin
Curriculum and Instruction
University of Houston
United States
brobin@uh.edu

Abstract: For the past six years, graduate students enrolled in an Instructional Technology web design course at the University of Houston have been learning technology skills by working on authentic educational web projects with community-based arts organizations. This article presents an overview of the projects that have been developed during this time and explores the process that has evolved since the course began in 1997. The article describes the changing nature of working with clients to create useful websites and develop meaningful technology-based resources for educators. In addition to describing the results of the collaborative partnerships between the community-based arts organizations and the university, feedback from various stakeholders will be examined, including the graduate students, the clients, and visitors to the sites. In addition, the next steps for both the course and the projects will be discussed.

Introduction

Since the fall of 1997, graduate students at the University of Houston College of Education have participated in the design and development of large-scale websites that utilize content from community-based organizations that deal with the arts. As part of a graduate level course offered through the Instructional Technology Program, *CUIN 7330, Educational Project-Based Web Design and Development*, students work directly with content experts and collaboratively, they design and create web projects that make use of artworks and educational information associated with both temporary and permanent art collections, as well as special projects put on by art museums, galleries and other community arts organizations. Successful educational partnerships are currently in place with the Museum of Fine Arts, Houston (MFAH), the Blaffer Gallery (the campus art museum of the University of Houston), and the Art Education Department at Texas Southern University. Students, who may have thought when they enrolled in “just another web design course,” and that they would only be learning more web design skills, find themselves immersed in real-world experiences with real community issues, working with different stakeholders to create web projects that will be used by diverse audiences. Depending on the number of students enrolled in the course in any given semester and the scope of the projects being developed, the makeup of the course may differ. In some semesters, all the students in the course may work on different sections of the same website project, while in other semesters, several student teams may be working on two or three different web projects. The common thread in this website development system is that each student works as part of a team and each web project is divided into different components.

Several articles have already documented the initial work of students in this course as they created the first group of projects (see references below). Now six years into the course and with a series of web-based projects already completed, the focus of the course has begun to shift. In what might be termed, the first phase of the project-based web course concept, the emphasis has been on how to conceptualize and create an elegant looking website that contains a balanced mix of informational and graphically pleasing content on one side and an assortment of educational resources that can be used by educators, their students and other interested web visitors on the other side. In the current, second phase of this course concept, the focus has shifted to adding more interactive and communication-oriented resources as well as presenting more rich content to the web projects so that visitors to the sites, especially, education-oriented visitors, will continue visiting the sites beyond just exploring them a single time.

Theoretical Framework

The initial design of the first phase of the University of Houston course took into consideration the needs of the first group of clients and the expectations of the early groups of students. However, after the course had been offered several times, and feedback from students and clients was collected and investigated, it became apparent to the instructor that the course could be improved by taking advantage of the work of other educators who had developed project-based activities. A few of the resources that were explored are shown below.

Tom March, one of the early developers of WebQuests, an inquiry-oriented educational web activity for students, has written a number of articles that describe a broad contextual framework for using the web as an educational resource. His work seeks to help teachers find ways to create and maintain “custom-designed web-activities for students.” Describing the major components of WebQuests (March, 2000), he maintains that web-based inquiry activities have the power to increase the richness of students’ learning through increased relevance and greater motivation. These activities, March emphasizes, engage both students and instructors in “a creative process that is both simulating and professionally rewarding.” This concept clearly expressed what we were seeking to create.

In another article, (1997) March and Puma describe how student teams are matched with non-profit community partners and work together to create compelling web projects that span across many curricular disciplines. Their article deals with Internet-based community action projects and struck a resonant chord with this author by emphasizing the notion that students become empowered when they work on actual projects with actual clients. The core concept is emphasized in the following passages: “By having students work in collaborative teams, facing the high-pressure task of completing a large project for professionals in the real world, the classroom itself became a testing ground for managing group dynamics and interpersonal skills;” and “...the power of telecommunications enabled a compelling learning experience that both challenged and supported students as they saw how others valued their efforts, knowledge and creations.”

In Miami, high school student teams participate in Web Design Academies (M-DCPS Website, 2003) where they learn to build professional websites for non-profit agencies and community organizations. Using a model developed with Apple Computer, this project-based approach allows the students to participate in “more than just web design.” By working with community clients, the students learn to work in teams, enhance their communication skills, and gain experience in project management and planning. Again, this model was similar to what we were trying to do.

We also explored what others were doing in higher education. Frost (2001) describes a community partnership model at the University of Michigan that involves museums, libraries and performing arts groups, content specialists, K-12 educators and student information specialists in the creation of web-based learning activities. Frost’s model clearly lays out specific roles for each of the stakeholders based on their expertise, level of commitment, and ability to participate in the creation of digital resources.

The Educational Project-Based Web course described in this paper is based on a similar theoretical framework of those described above, in which the local community provides a rich context and resource from which our graduate students and faculty can participate in authentic learning tasks, work with real clients, contribute new perspectives, and design and develop meaningful educational products. The students in this course develop an extensive knowledge of the technologies of instruction as well as relevant scholarly and professional skills that include:

- proficient use of productivity, authoring, multimedia, graphic, and web tools;
- proficiency in planning, facilitating, and assessing learner-centered instruction;
- instructional design and development theories, models, and processes;
- creation of effective electronic learning materials to address such facets as design, layout, navigation, text, and multimedia;
- the ability to use technology to communicate with broad audiences for a variety of purposes and to locate necessary information through multiple sources;
- the ability to effectively work, problem-solve, and research through social interactions in diverse team environments, and
- fluency with technology planning and policy making, project and information management.

The Projects

Bayou Bend Collections and Gardens <http://www.coe.uh.edu/webscapes/bayoubend/>

Bayou Bend is the American decorative arts wing of the Museum of Fine Arts, Houston (MFAH). It houses one of the nation's foremost collections of American decorative arts dating from 1620 through 1870. The objects in the collection reflect the values, and aspirations of ordinary Americans and the website was designed to showcase both items in the collection as well as reach out to the community by providing educational materials that support these works of art. The most significant feature of this web project is that it was the first one undertaken by students in the Project-Based Web Design course and it led to a much stronger relationship with the MFAH.

The Grandeur of Viceregal Mexico <http://www.fm.coe.uh.edu/>

In 2002, the Museo Franz Mayer, an art museum in Mexico City, sent a traveling exhibition to the United States, and to the Museum of Fine Arts, Houston. To supplement this exhibition, students in the course worked with MFAH staff to design and develop a website that would present information from the exhibit and include a rich assortment of supplemental educational materials. In addition to basic information about the exhibit, the final website contained a variety of online resources, including selections from the exhibition, an historical/cultural timeline, lesson plans, interactive games and simulations for families, and information about a cultural exchange program that allowed art students from Mexico City and Houston to visit both cities and explore art related to the exhibition.

The Murals of John Biggers <http://www.coe.uh.edu/webscapes/biggers/>

This website project grouped together graduate students with art educators from the University of Houston and Texas Southern University. The site, still in development, showcases the work of Dr. John Biggers, a nationally recognized muralist, and is an attempt to present answers to questions web visitors might have about his work and legacy. The site, like all of the projects developed in the course, was designed with multiple audiences in mind, including students, teachers, artists, and the interested public. The goal of the site to share Dr. Biggers' work and ideas with as many people as possible so that they may be significantly moved by an understanding of his work.

Chuck Close: Process and Collaboration <http://www.chuckclose.coe.uh.edu/>

The first project created in collaboration with Blaffer Gallery, the Art Museum of the University of Houston, was the development of web resources to complement a traveling exhibition of approximately 135 works by Chuck Close, a prominent American portrait artist. Students in the course collaborated with Blaffer Gallery Education staff to produce a multi-faceted online resource that featured an introduction to the exhibition, highlights of selected works, descriptions of the printmaking process used to create many of the works on exhibit, a detailed glossary and curricular resources for teachers and students.

Jessica Stockholder: Works 1989-2004 Working URL: <http://viking.coe.uh.edu/~smarsh/stockholder>

The second web project being developed in collaboration with the Blaffer Gallery deals with an upcoming exhibition and publication surveying the work of American artist, Jessica Stockholder. Thirty-five sculptures, wall works, and works on paper have been selected to exemplify the diverse range of Stockholder's art which will be presented in detail throughout the website. Educational materials and communication resources are in development.

Screening America Working URL: <http://discovery.coe.uh.edu/cuin7330f2003/dthomas/index.html>

Screening America is another MFAH program. It involves screenings of films and classic television shows by middle and high school students at the museum's auditorium, coupled with facilitated discussions to provide insights into American art and history. The graduate students are working with MFAH educators and local K-12 teachers and students to create challenging explorations of topics including immigration, the role of women in society, the criminal justice system, the Vietnam War, and presidential political campaigns. Developed in conjunction with the American Museum of the Moving Image in New York, the program enables students to gain a new perspective on history, literature, culture, and language. In addition, teacher program guides are being created that are aligned with the Texas Essential Knowledge and Skills, statewide curriculum standards for public school education.

The Stakeholders

A diverse group of stakeholders has been and continues to be involved in these web projects. Stakeholders include the graduate students who design and create the website projects; the clients, for whom the projects are created; the

subjects of the web projects, the visitors to the sites; and other identified groups, such as K-12 teachers and students, who have been recruited to help design, use and evaluate the sites or some of their specific components. Information about each stakeholder group is presented in the next section.

The Graduate Students

The graduate students that enroll in the course are typically Master's or Doctoral students in the Instructional Technology Program at the University of Houston. However, because of the arts-related nature of the projects, students from other disciplines, such as Art, Art History, Social Studies Education, and History, have enrolled in the course. One interesting aspect to the course is that it does not conform to the normal academic calendar. Since the projects are large in scope, they take longer to complete than a single semester. Therefore, different classes of students come into the projects at various stages of development and usually must pick up where the previous group of students left off. This has added an interesting dynamic to the structure and flow of the course and the design and development work and has contributed to some negative effects among some students. For example, a few students complained that their creativity has been stifled when they are asked to continue working on a project that other students began designing. In addition, some students who worked on a project early in the process were frustrated by the fact that not all of the content was available to them, that the makeup of the site had not yet been determined and that the clients changed their minds about what they wanted. Other students, who came into a project toward the end, as it was nearing completion, had the opposite concern, and were frustrated by the fact that most of the "fun part" of designing and developing a large-scale website had already been completed by previous student teams.

In the hope of improving the course and better dealing with these concerns, the last several classes of students were asked to comment on their experience in the course. Questions included: What do you feel were the biggest challenges you faced while in the course and while working on the project; What do you feel were the greatest accomplishments you had while in the course and while working on the project; What do you feel were the biggest disappointments, if any, you had while in the course and while working on the project; and What were the most significant things you learned from being in the course and from working on the project? Students were also given the opportunity to make additional comments about the course and their work on the projects. Table 1 below shows some of the results of this investigation.

Biggest Challenges	Greatest Accomplishments	Biggest Disappointments	Most Significant Things Learned	Other Comments
Unsure at the deal with an assertive client.	Able to create website client was happy with.	Not being able to complete the project .	How to work for a real client & focus on their vision for the site.	Would not recommend the course to students with minimal technical skills.
Worried about working in a team where members had varyin g skills.	Website was true to the subject's vision, and was cohesive & informative.	Not enough time to experiment, would like to have learned more JavaScript.	How to distribute responsibility in a team.	Project was unusual and challenging, but a wonderful learning experience.
To create an identity for the site	Zeroing in on an identity and design.	Not enough time to work with so much content.	How to use FrontPage & not to be intimidated by the skills of others.	Enjoyed this course because it required students to truly integrate technology into a learning situation.
Trying to effectively manage our group's progress.	Ending the semester with several usable components and ideas for where to go next.	That we didn't do even more with the project .	How to deal with and use the technology more proficiently.	It would have been good if our group had shared our answers to some of the questions asked in our earlier assignments about project goals and personal goals.
Learning to use FrontPage.	Being able to complete t he project by working together as a team.	Lack of time forced some of our projects to go unfinished.	What it takes to design something that people will actually want to use.	Was the closest thing I had experienced to working on an actual consulting job with a design team.

Biggest Challenges	Greatest Accomplishments	Biggest Disappointments	Most Significant Things Learned	Other Comments
Unclear expectations of the client.	Ability to produce a very professional looking web site.	Lack of ownership other students, who later became involved in the website, seemed to have for the project.	First time for me to work on a "real" project.	I think the focus of the course should be on project management and teamwork, not new skills development.
Frustrating that design changes were suggested almost on a weekly basis by our client.	Creation of an educational website that would serve as the focus of my dissertation research.	It took so long- that it was difficult for the people that came in the 2nd semester to understand the value of what had been done in the 1st semester and build on it rather than tossing it all out and starting over.	Working in teams can be difficult but rewarding.	Each student should have a designated role, which is assigned by a project manager based on their skills and interests.
Figuring out what my role was.	The clients were excited about the depth of content.		Good website design just ain't as easy as it looks.	I really enjoyed the times we met at locations away from class.
The client wanted to leave the creative aspect very open, and yet had very definite preferences.			Goals should be agreed upon early in the process and they should be as specific as possible to minimize miscommunications and lost time.	Open-ended directives are not as desirable as one may envision.
The balancing of the contradictory demands of accessibility for users and developing a dynamic visual imagery was a dilemma.	A design for an attractive and functional theme or look has been developed. The development of content has hopefully created a site that reaches a broad audience with multiple points of entry & adds an in -depth look at the artworks themselves.	Too much miscommunications and lost time between team members.	Miscommunication could be lessened if each team member submitted several ideas for each component, read and reviewed each other's ideas and had the opportunity to discuss the ideas and come up with a collective decision.	The client had very strong responses to graphical imagery. She wanted something strong and moving. It was interesting that the distortion of the art works wasn't an issue, although we almost dismissed the idea because of that aspect.
Motivating team mates to meet deadlines.			I have worked in many group projects but never really was the leader of a project. I learned more about working in a project and managing it than anything else.	It might be helpful to make questions for the clients before the first meeting that will reveal more specifically the scope of the project.
Difficulty arose in making decisions about the use of images because of concerns about copyright.				I was very impressed with the relationship that formed between the team & the client. They were truly professional and punctual in communicating with us and really made this project a priority.

Table 1: Feedback collected from graduate students who participated in the web design course.

The Clients

The director of the Blaffer Gallery described the partnership between the graduate students and the gallery this way: The strength of the partnership is its educational focus, in which art education students learn to integrate innovative technologies into their course of study while IT students learn how technology resources can and should be designed to complement real-world projects. This collaborative project serves as a model for creating important art and technology partnerships which can be worthwhile for museum educators harnessing the power of the web, for students creating real-world technology projects while working with actual clients, and for faculty who are transforming their courses into exciting new learning environments that are challenging and educationally meaningful.

In addition, this client contacted the instructor to express her feelings about the Chuck Close website and the still in development, Jessica Stockholder website. Her messages appear below:

Message 1: I don't know if I ever really told you how extremely happy we all are about the results of our collaboration on the Chuck Close web site. It is really wonderful. Last week I had the opportunity to sit with Chuck himself and go through the site. He loved it!

Message 2: As the semester draws to an end, I just wanted to take this opportunity to express once again my admiration for, and appreciation of, the team of students who have been working with me on the Jessica Stockholder website. They made great strides, and were incredibly creative. There is a lot more to accomplish, and I am sure that there is enough creative work to do for another team to pick up next semester. I hope that you will continue to be supportive of this endeavor! We continue to get positive feedback on the Close site, and I'm certain that the Stockholder site will be equally loved.

The director of the Education Department at the Museum of Fine Arts, Houston, who served as the major client for the Grandeur of Viceregal Mexico project, had a somewhat different view. She believes that the strength of the partnership, its educational focus, was also its major drawback. Students, who worked on the website over a two year period, with a new group of students entering the project at least twice a year, were a very diverse group with little or no background in art or art history. The pace of progress was often slow and frustrating from the museum's point of view, although necessary for the students' learning. In the educational setting of a graduate course, students need to try several approaches before reaching a solution and give and receive critical comments of their work. The museum education staff, which serves as both client and teacher, sometimes found themselves in a conflicting role as they attempted to teach students but also wanted a professional, polished website. But overall, the project was rated as a success, as measured both by the quality of the Grandeur website and the willingness of the museum educators to continue working with new groups of graduate students on new projects.

The Subjects

In the case of several of the web projects, a central figure played a prominent role, as they were the major subjects of the websites the students designed and developed. The artists, Chuck Close and Jessica Stockholder, are still living (and creating art) and the materials that appear on the sites needed to meet their approval. As noted earlier, Chuck Close has seen the completed website created by the students and approved of it ("He Loved it!") and Jessica Stockholder has expressed interest in participating in the final development of the site featuring her work. John Biggers, Franz Mayer, and Ima Hogg (the collector and original owner of Bayou Bend), the subjects of three of the earlier web projects, are deceased, but the depiction of their works, lives and collections are cared for by museums, universities and other stakeholders. It is these people and organizations who act on behalf of the subjects and with whom the students must interact, in order to gain approval for the content and design of the websites. This situation can sometimes be difficult and has created the need for the students to deal with multiple layers of understanding and become immersed in complex relationships that have formed between the artist and those charged with preserving the integrity of their legacies.

The Web Visitors

Web visitors are also important to those involved in the design and development of the web-based projects. Those who visit the sites provide an interesting view of how the site is being used as well as a great opportunity for research and analysis. Usage data were collected for the Grandeur of Viceregal Mexico website and provide an intriguing look at such areas as how many users visited (and are still visiting) the site, which pages on the site were the most popular, where visitors came from, and which search engines and keywords were used to find the site. A more detailed view of this process may be found in an article by Pierson, McNeil, & Robin, (2003), but a few of the highlights are discussed below.

Using the program, LiveStats (from DeepMetrix, Inc.) to measure web traffic on the site, data showed that many visitors came to the Grandeur of Viceregal Mexico site by way of search engines, such as Google and Yahoo. With Google, LiveStats data showed that the two most frequent keywords users typed in to find the site were "lessons" and "plans," with the terms "art," "furniture," and "ceramic" next on the list, but lagging far behind. Another interesting finding from the usage data indicated that the number of visits to the site increased after the exhibition at the museum ended. The data indicated that, on average, the largest number of visits occurred on Mondays and the lowest number of visits occurred on Saturdays. Additionally, we found that the greatest number of visits took place during fall and winter months, with the lowest number of visits taking place during the summer. One theory is that a

large number of educators are accessing the site and using the online materials during the school year, which is exactly what we hoped for when creating the site. We are continuing to follow the site's usage to see if this pattern continues. Furthermore, the LiveStats software is being used to track some of the other sites so that we will be able to collect and use data to compare the similarities and differences related to how users access and use the sites.

K-12 Teachers and Students

During the fall, 2003 semester, the graduate students in the course began working with Dr. Robbie Moses, a high school teacher at the Middle College for Technology Careers High School. MCTC, located on the campus of Texas Southern University, is a magnet high school designed to motivate and challenge students interested in developing technological and college preparatory skills. During our initial meeting with this group of public school students, the discussion focused on the Screening America website project and more specifically, on what content and resources could be added to the site to make it more appealing to them and other teenage students. The discussion was quite revealing and provided the graduate students with numerous ideas for improving the web resources as well as seeking ways to include the high school students in helping design and develop their own sections for the site.

What We Have Learned

The University of Houston Educational Project-Based Web course described in this paper was first offered in 1997. During that time, the course has been modified as new ideas and realizations about the course and the development model come to light. Feedback has been collected from students who have completed the course, the website project clients and other content experts. The access patterns of web visitors has been carefully examined and used to make improvements in the structure of the course. At the conclusion of each semester in which the course is offered (currently the course is offered twice per year, once in the fall and once in the spring), the course has undergone a re-design where changes are made to all aspects of the course, beginning with the weekly topics that are covered in each class. Each week's reading assignments are examined and new material is located through extensive web-searching so that the readings more closely match the weekly topics. Also, the written and hands-on assignments for each week of the semester are modified or replaced so that they will be more relevant to the design and development work that is taking place with the client. Furthermore, the requirements for the final semester project, which each team is required to complete, are re-evaluated to take into consideration new understanding and insight about the working relationships between students and their clients as well as the evolving expectations of web visitors in terms of the technical, graphical and written sophistication of web material. Finally, each new group of students is allowed to review the assignments and final project reports that were submitted by the previous student teams. This continually "raises the bar" for the newer students, since each new group wants to "out-perform" the previous group. However, this iterative process also helps the newer students as they are able to benefit from the successes, and failures, of the earlier groups.

The Next Steps

After several years of offering the Educational Project-Based Web Design and Development course, the web projects that have been completed have provided many educational benefits and challenges for the students and instructor. The partnerships formed between the Instructional Technology Program and the community arts organizations have also yielded much new understanding on both sides and strengthened the collaborations. The graduate students have provided an abundance of useful feedback by sharing their accomplishments, challenges and frustrations in being part of a web design and development team. For their part, the clients and the subjects of the websites or their representatives have greatly increased the learning experiences for the students by providing a rich assortment of real-world issues that must be dealt with. Taking all of this information into consideration, a number of next steps have been identified and are being integrated into the structure of the course. The list below includes items that will be integrated into the course as it moves into its second phase, by increasing the amount of time spent on project management and working with clients, and focusing on making the web projects more interactive and thereby, more useful to students and teachers and other visitors to these sites. The items that have been added to the course during the spring 2004 semester include:

1. Discuss the expectations and requirements of the students earlier in the semester;
2. Have students discuss personal and professional goals earlier in the semester;

3. Develop questions for the clients that will reveal more specifically the scope of the project;
4. Have each student choose a designated role based on their skills and interests – this differs slightly from the recommendation that the project manager should choose a designated role for each team member and gives students some voice in the role they will play within the team;
5. Designate, or have each team designate a project manager for each collaborative group and spend more time on project management and teamwork issues instead of just new skills development;
6. Have more specific assignments with less “open-ended directives” for students;
7. Work more with public school teachers and students in the design, development and evaluation of educational resources;
8. Add more multimedia clips (such as those demonstrated on the Screening America site, at: http://discovery.coe.uh.edu/CUIN7330F2003/kaksoy/Nov22/12angry_men/interviews.htm) to the sites and work on resolving copyright images;
9. Increase the use of data-gathering software on current and future web projects; and
10. Add communication resources to the sites.

It remains to be seen how effective these strategies will be. However, it is certain that as we progress in this educational partnership with arts organizations in our community, we will all learn more about the nature of working together to build strong partnerships as well as educationally meaningful web projects.

Course website: <http://www.coe.uh.edu/courses/cuin7330/>

References

Frost, C. O., (2001). Engaging museums, content specialists, educators, and information specialists: A model and examples. *Museums and the Web2001*. [Online]. Available: <http://www.archimuse.com/mw2001/papers/frost/frost.html>

Hecht, P., Springer, J., Milman, N., Robin, B., Schneider, B., McKay, S., McNeil, S., & Smith, D. (2002). The convergence of teacher education, art museums and instructional technology: Goals, insights, and recommendations. In D. Willis, J. Price, & N. Davis (Eds.), *Information Technology and Teacher Education Annual 2001*. (pp. 16-18). Charlottesville, VA: Association for the Advancement of Computing in Education.

March, T. (2000). *The 3 R's of WebQuests: Let's keep them real, rich, and relevant*. [Online]. Available: <http://www.infotoday.com/MMSchools/nov00/march.htm>

March, T., & Puma, J. (1996). A telecommunications-infused community action project. *THE Journal*. [Online]. Available: <http://www.thejournal.com/magazine/vault/a150.cfm>

McKay, S. W., Rapp, M., Robin, B., & McNeil, S. (2003). The evolution of Webscapes: A theoretical framework for the collaborative design and development of interactive learning environments. *World Conference on Educational Multimedia, Hypermedia and Telecommunications 2003(1)*, 3038-3039.

M-DCPS Apple Web Design Academies. (2003). [Online]. Available: <http://portal.dadeschools.net/webacademies/>

Pierson, M., McNeil, S., & Robin, B. (2003) Data-driven usability assessment: Using multiple forms of online feedback to improve e-learning design. *E-Learn Proceedings, 2003*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Robin, B., Jenkins, A., Howze, W., & O'Connor, K. (2001). A museum-university partnership to develop web-based educational resources. *Museums and the Web2001*. [Online]. Available: http://www.archimuse.com/mw2001/abstracts/prg_95000411.html

Robin, B., McKay, S., Schneider, B., McNeil, S., & Smith, D. (2002). A model for creating an art museum-university partnership to develop technology-based educational resources. In D. Willis, J. Price, & N. Davis (Eds.), *Information Technology and Teacher Education Annual 2002*. (pp. 11-15). Charlottesville, VA: Association for the Advancement of Computing in Education.