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Abstract

The five-phased process for building Web sites in the classroom may be useful in helping educators facilitate the process of integrating computer technology and the Internet into instruction and curriculum design. The method described is a synthesis of a personal process of discovery, teaching, and learning that has come from practical experience with teachers and students. To effectively utilize this five-phased approach, the instructor must ascertain the final goal, whether it is a curriculum product, Web site, oral presentation, or some other form of demonstration of learning. The identified phases are a set of guiding principles that at any time may be revisited depending on the progress of the teaching and learning. In this approach, the instructor truly facilitates the learning process, no longer standing in the front of the room as the expert, but working alongside each learner to assist them in learning moments that are meaningful and timely in their delivery.

Introduction

As an educator using technology, you may have encountered teachers who ask, “How am I going to teach this unit using technology?” or, “How can I use the Internet in order to keep my students interested and showing up for class?” As instructors, we often search for new methods of instruction, new skills to implement in the classroom to better meet the needs of our students. Most of us also possess a commitment to lifelong learning, constantly striving to improve our abilities in subject matter, pedagogy, and educational technology. One in-service teacher educator with 15 years classroom experience stated, “I was struggling as a teacher. Not with discipline or classroom management. Not in personal interactions with the students or administration. Not with the content of science. No one in fact, except those I told, knew that I was searching for a better pedagogy—a better art or science of teaching.”

In working with both pre-service and in-service teachers in order to develop curriculum for the World Wide Web (WWW), I have organized my instructional approach into five basic phases: planning, research, development, refinement, and implementation. These five areas work as organizational frameworks for instruction and learning, curriculum development and implementation, student progress and presentation. It also infuses the use of computer technology tools with a specific purpose. The goal is not solely to learn how to make a concept map with great pictures or to develop an attractive Web site, but to imbed the use of educational technology within a task. In this way, the tools enhance and facilitate the learning process. This gives the learner a reason to use the application, and along the way, the learner understands how the application works.

A practical approach to building Web sites in the classroom integrates effective pedagogy with computer technology in a project-based curriculum. In order to purposefully integrate the resources and the tools of the Internet into a program of study, a five-phased process for building Web sites in the classroom can be a valuable framework for the classroom teacher. Adding telecommunications to the classroom empowers the learners to develop shared understandings of content material and to construct knowledge that is measurable by the classroom teacher. "The student's power to better control his later experience is grounded not so much in the teacher's authority as in the student's understanding of how educative materials enhance and enlarge the range of experience" (Gowin, 1981).

As a former science teacher in middle and high school, I was always interested in helping students make real-world connections in a project-based curriculum. With the increased availability of computer technology and Internet resources, I saw an even greater avenue for instruction. In the past, I have also

worked with hundreds of teachers and students in science and technology education programs while I was employed at Los Alamos National Laboratory. Over the past three years, I have taught the integration of technology in a process of curriculum development in New Mexico and currently utilize this instructional method in my position as an Assistant Professor at the University of Texas at El Paso. The method described in this article is a synthesis of a personal process of discovery, teaching, and learning that has come from practical experience with teachers and students. The following framework may be useful in helping educators facilitate this process of integrating computer technology and the Internet into classroom instruction and curriculum design.

The Planning Phase

The objective of the planning phase is to define the current knowledge base and to develop the foundation for the organization of learning. The software utilized to facilitate this phase is Inspiration Software, which is a visual graphic organizer and concept mapping tool. The planning stage is the first stage, and is often the most critical. As one teacher educator commented, "The most helpful part may be the backward planning. I believe that developing what you want to be the everlasting knowledge first is going to help me tremendously. Formalizing the steps people go through in creating a project has already helped me and has started me thinking on implementing this model in other classes. Actually giving names to the steps will enable me to create evaluations for not only the product but for the process also."

This is the point where the instructor has to provide a theme that will create interest in the learner to continue with the process over the months to come. For example, the theme may be to develop a structure to colonize Mars with inhabitants of Earth. Often, the instructor can set the hook by posing an open-ended question that frames the context of the subject matter to be studied. An example might be, "What would we need to do in order to live and function on a distant planet, let's say Mars?"

The instructor can begin the lesson by brainstorming what students already know about sustaining life and the needs within a community. These items can be put onto a white board, chalkboard, or butcher paper. Yet, this is a moment where the technology can be integrated with great ease and efficiency. Inspiration is a concept mapping software that permits the user to define the relationships that exist in their knowledge structure. It also allows the user the flexibility to shape, move, link, draw, connect, arrange, and rearrange the individual concepts and ideas. The instructor can instruct educators using concept mapping strategies and software, and in turn, the teachers can model this to the students. "Although the faculty will not be able to anticipate all of the ways students will shape what they learn (nor do they wish to), there are some principles and interrelationships they hope to highlight" (Edmondson, 1995). Students are then set on a task, such as planning the elements they would need to have in place in order to colonize Mars.

Next, this process should incorporate a diagram made with Inspiration software of what the basic files and folders will be on the Web Site. It is also good practice to name the files and folders in a short and easily understood manner. All folders and files must be contained within a single folder, called the "root folder". This is the highest level of the site, and all files and other folders (sub-folders or sub-directories) must be contained within this root folder. As for individual Web pages, they should end in a format recognized on the Internet (such as .htm or .html). All the folders and files should also be in lowercase and without spaces. For instance, the root folder could contain the first page (or home page) of a Web Site, which by convention is often entitled "default.html" or "index.html".

In order to facilitate moving the curriculum to the Web, the learner must understand the organization of the site and its management as fundamental concepts in order to effectively update, add to or change information that is posted on the WWW. Most importantly, the Web site should look the same on both the local machine and the server. To reach this end, the learner will need to construct a plan for the Web

site using Inspiration software to effectively organize the directory structure and file locations, and then implement this plan (or schematic diagram) as they build the site. In the end, the folder and file structure on both the local and remote sides should match and in effect mirror one another in structure and content.

It is very tempting for learners and instructors to just jump in and start creating pages, or start changing existing pages without a clear and understandable purpose for the site. Therefore, it's a good idea to start by asking at least these three simple questions:

1. Why is the Web site being built? Many Web sites exist just to keep up with "technology". The designer needs to define the purpose or reason for placing their information on the Web.

2. Who is the intended audience for the site? The student should determine if the Web site is for a specific age group, specific grade level, or the general population. This will help to direct the exact types of information needed and also influence the design layout of the Web site.

3. What is the format for the Web site? There are several ways to layout a site. Decide if the user needs to follow a certain path, or if they can freely explore any direction.

As learners work through the planning process, there will be many terms that they know and many that they don't know. There will also be gaps in their content understanding and information resources. Questions can now be formulated to frame the research, and learners can use the tools of the Internet in order to further their knowledge base and understanding of the topic. The instructor can then gather the groups back together at a later date, pose the same question that began the lesson, and then revise the concept map with ease and flexibility. This modeling process will help frame the use of the technology tool in a given context. As one teacher educator wrote, "I became better at all the tools in general, but the most useful thing I learned was the importance, difficulties, and techniques of planning."

The Research Phase

The research phase follows the planning phase so that learners can explore the knowledge base and deepen it through independent or cooperative research activities. This includes searching on the Internet for useful sources of information, but also for sharing these resources in discussion formats. The skills of the instructor are critical to this phase, as strategies for information acquisition and evaluation are vital to research. To follow the previous example, the ideas in the concept maps and the questions that the learners generate can now be explored in greater depth by looking at sources on the Internet. Research activities give the students the ability to retain these facts by affording them the opportunity to think critically, to work through problems logically, and to make connections with the real world. The instructor cultivates student interests, but the ownership of the project rests squarely on the students. "The student's role is to reflect what is taught, and the function of practice is to strengthen the associations and receive correction when necessary; the teacher's role is to ask questions and provide confirming or corrective feedback" (Anderson, 1989).

The objective of the research phase is to allow the learner to explore the content area and to deepen their knowledge base. The computer-based tools for facilitating this phase are the various browsers for the Internet, which may include Mozilla, Internet Explorer and Safari among others, as well as the use of email for correspondence and information gathering. As one student commented about the use of the Internet in the classroom, "When my principal would ask me about using the Internet in my classroom, I would ask him how I was supposed to teach and be online at the same time. Now I know that I can do both." In the example of the Mars project, students should have a set of guidelines, including references of sources, yet the basic task should in no way be considered rote. To foster critical thinking is to put forth unique situations for students to study and to reinforce their ideas with citations of factual

information found in research. It should foster analysis, evaluation, and synthesis of information, all higher-order thinking skills.

As the primary tools of the Internet, browsers and email can be very useful at this point for research. With the browsers, many features can be shown and taught as a precursor to each individual research session, such as making bookmarks, viewing and interpreting the source code, clearing the cache, and setting the colors for fonts and links. The Web runs on a client/server model. It is important for the student to understand that a browser resides on the client's system, and to understand that the browser contacts a Web server and requests information or other resources, most commonly done in the form of a Uniform Resource Locator (URL). The Web server locates the information and then sends it to the client, which in turn displays the results. Additionally, the use of email is vital in today's research and is a nice complement to using Web sites for information, since it personalizes the exchange of information gathering. Of course, plagiarism should be discussed and avoided, and this is best accomplished by requiring a unique student task that will frame the research. In this way, the context of gathering content information and compiling research material allows the instructor to facilitate learning the functions of the tools, and to explore the options and features of the software within the task of researching a specific topic or communicating with content experts.

This may lead the learner back to the planning phase to deepen and broaden the knowledge base, since the research will allow for greater content to be added to the concept maps and research-driven questions. Often when learners have little practical understanding of a subject area, their research will only drive them to understand how little they actually know about the topic. It may also reinforce the fact that they know a lot about the area of study. However, Web information differs in levels of accuracy, inquiry, and accessibility to learners (Gralla, 1996). Some Web sites present science as a body of uncontested facts, an oversimplification of complex phenomena, or a combination of abstract scientific ideas that require more explanation. Only a handful of Web sites provide curricula that address national science education standards, follow sound pedagogical practices, support scientific inquiry and engage in active thinking (Linn, 1995). At this point, the instructor can facilitate sharing using concept maps and information gathered from Web sites and email. The learners can share this information and create a deeper collective understanding.

The Development Phase

The objective of the development phase is to provide the learner with the opportunity to construct their knowledge following the scope and sequence of the curriculum. The software tools utilized by the learner would include Inspiration and word processing software, such as Microsoft Word, Word Perfect or Apple Works. Now the learner is ready to put their ideas into a format that can lead to a demonstration of their learning. Remember, the original scenario was to develop a structure to colonize Mars with inhabitants of Earth. How will the students go about doing this? What will they do to make sense of the work they have done so far? How will this result in a viable presentation? These are important questions that the students need to discover and strive to answer. Again, students begin this phase by revisiting their planning efforts and identifying the areas they are to work on to complete the task. This is coupled with reviewing their research in order to discover ways to put their ideas into reality.

Inspiration will be a valuable tool to revisit in this stage, as learners can map their ideas, rearrange them, and create an outline from the concept map that can be used to write up their plan. The word-processing software can be introduced at this time, yet this may be the one tool with which learners have the most experience. Now, the technology tools are framed in another context for learning and can be integrated for the development phase. Copying the Internet address (URLs) from the browser and pasting them into the document is one example of this type of integration. Also, information from the Internet can be synthesized into a document that can become the research base for the final product.

Technology can be an ally to the modern teacher, and should be effectively integrated into the presentation and demonstration of the curriculum. This takes a different style of teacher, one who learns from students and also models the use of technology in the classroom (Duffy et al. 1986). Today's learner needs to be stimulated, and since technology is an integral feature of the modern world, to not use it in the classroom is a real disservice to the student. In education, "technology provides the eyes and ears of science - and some of the muscle too" (Rutherford and Alhgren, 1990).

The Refinement Phase

The objective of the refinement phase is to further the development and to lead the learner to the implementation phase. Again, the user will utilize familiar software tools (Inspiration, word processing software) as well as Web site editors and the basics of HyperText Markup Language (HTML) instruction. HTML is the language used to prepare Web hypertext documents. HTML contains commands, called tags or elements, to mark the text as paragraphs, headings, lists, characters, tables and more. An element is a fundamental component of the structure of a text document. Think of it this way: you use HTML tags to mark the elements of a file for your browser. Elements can contain plain text, other elements, or both. This allows the user to make the transition from understanding how a Browser functions as a viewer of Web pages to exactly how Web pages are constructed.

At this time, the learner (or teams of learners) should proceed to refine their work and make it ready for public dissemination. It is at this point that the Internet is most powerful and when the motivation to do good work becomes intrinsic and not driven by the pursuit of a grade. It is one thing to do a project and turn it into a teacher in your school, it is quite another to publish your work on the Internet for anyone around the world to read and consult. "Particularly in higher education, high value is often placed on academic discourse, i.e. developing student skills of analysis, constructing and defending an argument, assembling evidence in supporting an argument and critiquing the work of scholars and fellow teachers" (Bates, 1995).

Now, the need for refinement becomes clear and the instruction can center on the tools of Web building, primarily the use of WYSIWYG (what-you-see-is-what-you-get) editors and the use of HTML coding. This couples well with the use of the word-processing software in the development phase where much of the crafted text can now be pasted into Web-based documents. Software such as Dreamweaver or Adobe GoLive are good examples of graphical Web editors that are useful for both instructors and students. They offer a number of template formats for ease in design and also write good quality code that works well across platforms including Mac, PC and Unix.

Now, the refinement may center on finding images to enhance the presentation or the planning of links within the Web site. Up to this point, all the Web site project development has been done locally on a classroom system. All files (text and images) must be in the main folder, and a user should be able to move between all the pages on a site within a given folder. Linking pages together in this way is using "relative links" as opposed to "external links," which are URLs that reside outside the folder. Templates can also be used effectively at this point in order to provide a consistent page structure with locations for logos, page titles, links, and legal information. Templates contain the basic components that will appear within each page, and also are the area where the developer will focus on basic functions that they want within each Web page. The templates in Web editors like Dreamweaver and Adobe GoLive are similar to those students may have used in other applications like Microsoft Word or Microsoft PowerPoint. Web design templates give the student basic page structure and elements with which they can add their researched text and graphics to each page. Templates provide the beginning developer a starting point and also promote a consistency across the Web pages that can aid the navigation of end users.

The design of the final Web site, its hierarchy and organization, must be well thought out and put together. Students with multiple files may want to categorize the elements of the Web site and create multiple folders for different types of files or information. All images must be in the folder. One approach is to have a separate folder called "images" if there are a lot of pictures and icons. Extra folders are useful when building a complex site, but remember that all the links will change if this decision is made after the construction of the site has begun. This is where the planning is important from the start, so that a site doesn't have to be redesigned while it is being built. One classroom educator summed it up best: "I was dragged into the computer age kicking and screaming—starting 10 years ago. Now I don't know how I could work without it. As a tool, the computer is very versatile in the classroom."

The Implementation Phase

The objective of the implementation phase is to demonstrate the learning that has taken place through the phases. In order to successfully demonstrate this process, the learner will utilize the various software tools that have been used to this point (Inspiration, word processing software, WYSIWYG editors, HTML instruction) as well as an understanding of File Transfer Protocol (FTP). Now is the time to put it all together and see what learning has taken place. This is the final exam, the implementation of an end product that will be the focus for pulling all the material, ideas, and applications together. This should be done in a public forum to develop skills in communication and presentation. The learners should have some presentation options, and these choices should be given at the beginning of the assignment. However, the development of a Web site with specific criteria (number of links, images, content sources, etc.) can be a highly effective framework for this program of study.

By defining the final product expectations from the beginning, the instructor provides a context for students to utilize the computer technology and Internet resources into a cohesive project. From an instructional sense, the tools are overlapping and fluid. One new tool will be needed at this time, and that is the file transfer protocol (FTP [PC] or Fetch [Mac]). This allows the user to put their files (text, images, video, and sound) into a folder on a Web server for access by the outside world. Also, the tools of FTP are built into Dreamweaver or Adobe GoLive software and allow the user to effectively update and refresh their Web sites from within the Web editing software. The server is ultimately where all the Web pages will reside, yet it is important for students to understand that even after they have made sure that all the links work, all the paths are complete, and the content is accurate, they will still have to troubleshoot the Web pages once they are placed on the server. The Internet adage, "Web Sites are never done," should help the learner to comprehend that they can expect that updates, refinements and further enhancements need to be done regularly to the Web site, especially as the developer adds, edits or re-posts information.

For the instructor, this new knowledge can be added incrementally at the beginning of each lesson within this phase. It is also an appropriate time to use peer instruction and cooperative groups, as the knowledge students gain in applying software skills can be valuable to the progress and learning in the classroom. Regular times to share and collaborate should be woven into the classroom time, along with extended periods to plan, research, develop, and refine the work. This is also the point where the classroom appears most constructivist, in that learners are constantly putting their new knowledge to use and building on their previous premises. Often, each learner is at a different level in either content or process development, and the problems they encounter are unique and personal. The classroom is active, filled with discussion and group interaction, far from your basic drill-and-kill approach.

Conclusion

Utilizing this five-phased instructional process is one way to build a Web site that can take the form of a curriculum, lesson plans, instructional units, or presentations that integrate the tools of computer

technology with classroom content. In this way, the tools are not the focus of the instruction, but are imbedded in the facilitation of the learning process. Although instruction will surely center at times on a given application (such as making the links within a Web site), the learner is ready for the new information, has experience with the application, and is learning it in a context that has meaning and purpose. This five-phased instructional approach provides the instructor with the necessary framework needed to practically integrate Web sites into classroom instruction. For the educator, the computer should be used within daily activities, and lessons should be made relevant to the student and designed to match their needs and interests within the classroom activities. With the use of the Internet, students can use the computer to research specific topics and prepare presentations, while the instructor can implement specific assignments requiring students to use the computer as a research and reporting tool. These lessons should take students beyond mere assimilation of content and superficial levels of understanding to areas of synthesis, analysis, and evaluation.

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