Using Ubiquitous Tools and Web Services for IT Education

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***Abstract*—This paper reported positive experience with the application of ubiquitous tools readily accessible to students for IT education. The adaption of instructional approach to include widely accessible tools and services offered solutions to IT instructional challenges in motivation, relevancy and costs.**

***Index Terms*— PBL, distance-education, e-forum, Web Services**

I. Introduction

The Net (Internet) generation generally refers to those children born between 1986 and 2000. The first waves of these youngsters are already on university campuses [1] and triggering major challenges in the educational process, especially in IT education.

The Net generation has been brought up among edutainment, and expects learning to be fun. They are avid users of computer and Internet, and are much less tolerant of boredom than previous generations. They exhibit no fear for computers and feel no need for computer literacy training. They probably have experienced and even master technology that baffles the current generation of instructors. They are accustomed to obtain information on their own and expect instant feedback. They are crafty at the assembly of information reports from web excerpts [2]. They learn just in time, and are less willing to memorize information as a necessary part of the leaning process. They will not hesitate to turn to powerful computational machines to complete tasks. They are keen at locating and learning software and hardware for task completion, and developed preferences for IT tools and web services. The Net generation will be less inclined to follow a curriculum, simply digest bundled knowledge, and equate hard work with learning [3], [4].

This paper documented positive experience in the utilization of ubiquitous tools and web services to meet the challenges of providing IT education to a new generation of learners.

II. IT Education Challenges for the Net Generation

There were at least three challenges in the delivery of IT education to the Net Generation. It has been challenging to allocate limited instructional time to cover a rapidly expanding list of relevant tools and web services. Motivating students to invest time to learn the selected tools and web services proved to be equally challenging. Lastly, there were enormous financial and logistical obstacles in ensuring the accessibility of the tools and web services to the students.

The dilemma was, for every tool and web service selected for IT instruction, the students could identify several competing and even better tools and web services for the same application. Valuable class time consumed in the instruction of limited tools and web services distracted students from the learning process, even pushing students away from the IT educational programs [5], [6].

The rapidly changing IT platforms washed away efforts to upgrade educational IT infrastructure. The diversification of student interests spreading IT educational resources to the point of breaking, and still falling short of stakeholder expectations. A highly mobile generation of students demanded the availability of technology at their choice of time, location and communication channel, erasing the value of centralized training supports.

In 2003, a problem-based learning (PBL) approach was tested for IT instruction. The instructional focus was shifted from selected software and computer system to problem solving, and student were allowed to use any accessible software, computer and facility for learning. Many students elected to complete their assignment outside of the computer lab facility, and used class time to extend their learning experience. The PBL approach was subsequently introduced to upper level IT courses with satisfactory results. The remainder of this paper reports on the process of progressive transition to ubiquitous tools and web services for IT education.

III. Problem-Based Learning (PBL) and IT Education

The traditional IT educational approach frequently utilized project-based instruction. Students were expected to follow elaborate procedures in the reconstruction of tasks with predefined features and outcomes. Students were evaluated on their ability to complete the projects with the correct solution in a give time frame. Instructors may found themselves competing with the students through difficult problems that only a few students could completely resolve. However, students could be frustrated by the learning experience.

PBL involved using a realistic problem-solving challenge to be handled by either an individual student, or a team. Students were charged to determine and locate problem-solving resources, which were provided on-demand. Student teams could follow different paths of problem solving, and ending in a variety of solutions. Students learned through the solution process, and through comparing their solution methods with other teams, and through feedbacks from the instructor. As a result, students learned both feasible solution methods, as well as the relative

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effectiveness of different solution methods. The creative students were also able to invent solution methods to solve the problem [7].

The rich learning context of PBL supported a broad variety of individual learning goals. While the average students learned the core skills, the better-prepared students could fast forward to advanced computing skills. Peer learning was a significant factor in PBL, and allowed the instructor to focus on motivating and teaching the few highly motivated students, who in turn set the standards for other students to achieve. Peer competitions promoted the pace of learning, and many students took pride in tutoring their peers while reaffirming their newly acquired skills.

In a tradition instruction-by-subject approach, students would spend enormous amount of time learning a large array of concepts and practicing skills. However, these students ending up forgetting a substantial portion of the knowledge, while ill-prepared to solve problems. PBL intended for students to learn on demand, taking the time to thoroughly examine alternative tools and solution methods. As a result, students retained the tools and methods deemed useful and meaningful to each of them. The repeated application of the selected tools and methods reinforced learning. A precious "teachable moment" appeared when a student who exhausted solution methods for a problem requested assistance. At that moment, the student would be eager to acquire additional tools and knowledge to continue solving the problem. The recognition of achievable targets motivated students to complete problem solving on their own, refusing the intervention of the instructor. This was a favorable factor since IT students would be expected to independently solve a large variety of problems at work [8].

IV. UBIQUITOUS TOOLS AND WEB SERVICES

The widespread available of web technologies and inexpensive, yet powerful computing technology decentralized IS services. Increasingly, students invested money and time on technology would expect the recognition of their choice of technology as a suitable substitute for the technology selected by the instructor and the educational institution. For example, the University of Guam collected a technology fee to provide students technical services such as an email account, centralized computer lab, and web services. A recent survey indicated that a majority of the students never use the campus email account even every student owned an active email account. The centralized computer lab was popular, but there were low utilization for satellite computer labs. Students taking courses in the satellite computer labs would show preference for the technology available at the central computing facility. This often placed the instructor in awkward position of facing questions on technology not available to the instructor. Increasingly, students brought in their laptop computers and requested instruction based on the latest versions of software installed in their computers! It was a fruitless effort to instruct students to use the campus subscribed electronic library services. Students overwhelming preferred to research through the Internet. Some students preferred to purchase online references, which was more readiness accessible then the complex procedures to access the e-library. Freeware, shareware, and free web services were popular among students, who gave little resistance to the use of these tools and services [9], [10].

V. SEEKING IT PLATFORM FOR WEB AUTHORING

Learning web authoring has been a popular request from students. However, students immediately ruled out HTML editors as learning tools. The instruction of basic web authoring tool such as FrontPage was met with resistance. Most students did not have access to the software, and they were reluctant to spend time in the computer lab to complete their assignments. For those who worked with the software, substantial instructor attention was required to address technical issues. Students completed assignments fulfilling the minimum requirement, with very little creativity and special design features.

The introduction of PBL approach modified the nature of the student assignments. Students were shown different web designs that could be easily created by common application packages. Some advanced web features were demonstrated with brief introduction of web authoring tools. The students were then assigned to use any available tools or web services to create website with specific features and linkages. The submitted works must be viewable use a web browser. The outcomes were impressive with students submitting simple webpage to those utilizing frames, and even animated graphics. The tools students utilized included word processor, desktop publishing software such as Microsoft Publisher, web-authoring tools including FrontPage, Dreamweaver, Flash, and other freely available shareware and freeware. Some students also used online web templates, and some created websites online using free website creation services. Many of the websites were highly creative with professional quality. Students responded positively to the learning experience; even many admitted being challenged and reported enormous time investment toward the completion of the assignments.

VI. MULTIMEDIA DATA SHARING

A challenge in IT education was to train students on the large variety of media formats, data representations and data security measures. However, the current generation of software was packed with so many tools that student did not feel the need to understand the core technical knowledge. When data files were shared through network, it was unlikely that all users would have access to the same collection of software in their computers. When a student failed to open a file with unrecognizable displays, a typical reaction was to conclude that a file error or software error had occurred. Another reaction was to request from the instructor a solution to resolve the perceived data file issue. The general understanding that students were to use tools specified by the instructor to solve problem actual blinded the students to tools and web services readily available to them through web services. Few students could distinguish the difference between file error and data coding incompatibility.

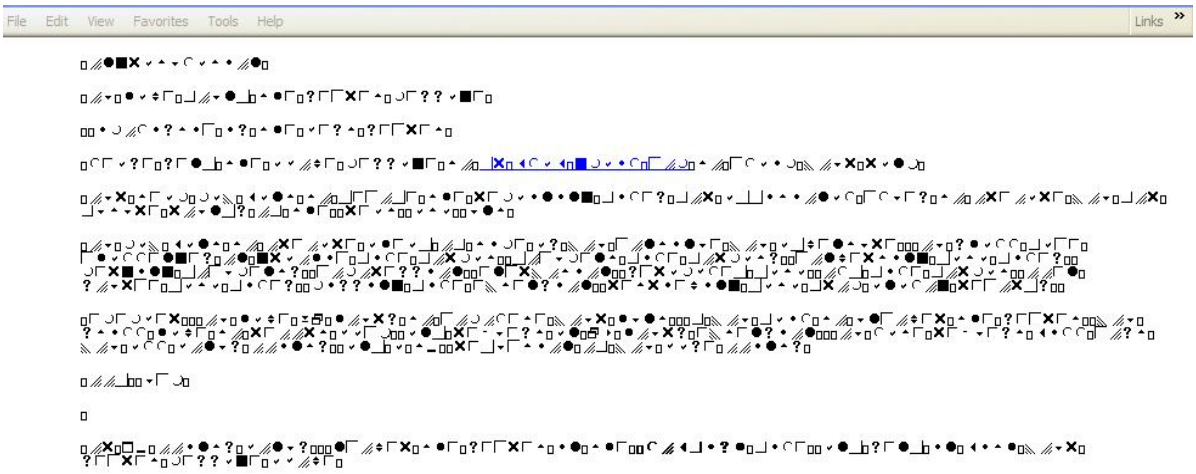

Fig. 1 Sample Data Challenge

An exercise was designed as a competitive game to instruct students on multimedia tools and data formats. The students were divided into competing teams, which must race against time to solve data file challenges for rewards. Each data challenge was constructed using common software tools such as browser, word processor, spreadsheet, media viewers, graphic file editor, and data file converters. The student teams were to identify and acquire the correct tools to open the data files and transforming the data files to unveil secret messages. The instructor did not provide any guidance to the student team on the appropriate tool to use, with the understanding that the student teams should not need expensive specialized software to accomplish their tasks in 48 hours.

On the day each round of challenge was scheduled, the appropriate data files were sent to student team email addresses as file attachments. All subsequent communication between the student teams and the instructor would be conducted only through email. The teams were able to continuously communicate with the instructor who would inform the teams whether they have completed the challenge.

Fig. 1 showed a sample challenge given to the student teams as html file. A hidden message was included in the file and the teams were to decode the message in the file and report the message back to the instructor.

Simple instructions were provided to the teams as shown in Fig. 2. An incomplete coding scheme as shown in Fig. 3 was included as a spreadsheet. The coding scheme was included to encourage student not to give up prematurely on a potentially complex challenge. The codes in the spreadsheet were placed in hidden columns to heighten the perception of secrecy.

The student teams were able to complete the challenge between 1 hour to 24 hours, and most teams were highly motivated for new rounds of challenges. In this challenge, the student learned about data formats, special spreadsheet controls, coordination and real time communication between team members who were involved in different classes and activities when the challenge started. There was minimal information sharing between the teams, since the teams were competing for ranking. Students with fluent knowledge of

Round 1 Instructions

An ancient tribe has created a secret message, packed with data hunting advice.

Uncover the secret in the message and you are ready for a special reward.

The most useful ancient code book has been included for your use. Discover the secret in Message 1.

Fig. 2 Instruction for Teams

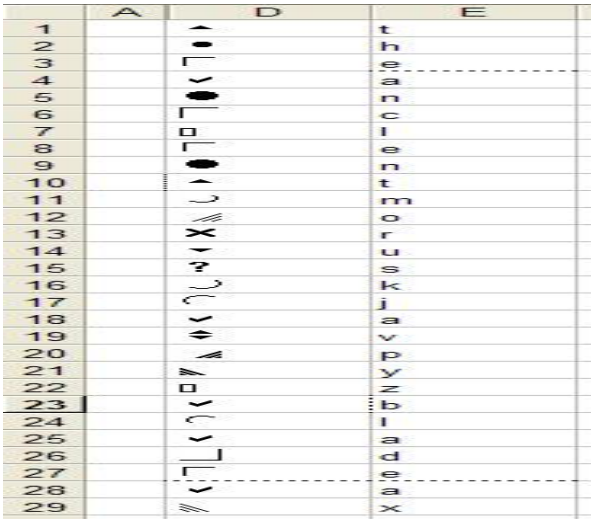

Fig. 3 Coding Scheme

software could complete the assignment with a word processor in less than two minutes!

Other challenges were designed for the students who were very resourceful in locating or download software to complete the challenges. Five out of six teams completed all challenge rounds, with only one team dropped out of the race. Student learned technical knowledge that they would have neglected under regular instructional approaches.

VII. VIRTUAL LEARNING

A hybrid virtual course was created recently to

accommodate a surge in demand for IT courses that created course-scheduling challenges. The virtual course was designed to substantially reduce physical class meeting by moving discussion and interaction to electron media. Since the virtual course was created with one-week notice with no additional resource support, creating formal interactive web applications was not a feasible option. One obstacle was the substantial preparation required to shift instructional contents to distance educational web services such as Moodle, which was available on campus. The greater obstacle would be the required training and orientation for the students for the new tool, effectively introducing a new layer of instructional activities that required physical meetings. Unstable campus web service was also a concern since the limited bandwidth translated to limited access and slow response during high traffic period.

A simple html based E-forum application was considered. The E-forum application has successfully hosted a faculty forum on Distance Education. However, extracting comments from the forum was time consuming with the limiting functionality of the application. Email, wiki, and e-forum applications were considered. Email was readily available, but tracking comments from participants would be difficult. Email transmission was occasionally problematic, and there was a potential problem of spamming when some participants reply email to all. A simple blog service offered by Google was selected to support the electronic forum. All students were able to sign up for the web service by activating an email account. Students were able to post and retract comments at will, with option to conduct interactive discussion through additional comments. Soft rules were established to ensure that all students participated in the forum in limited time frame. The instructor chose to use email to debrief the class on the forum to ensure all students received the instructor comments in their primary email accounts

The student participation rate in the e-forum was nearly 90% compared to about 40% participation in another section of the same course in which the class met physically with the instructor twice weekly. The insight students contributed through the e-forum were of very higher quality, reflecting a mastery of the reading materials. Some students actually conducted in-depth research in preparing their response to the e-forum. In comparison, students in the regular class constantly failed to complete reading assignments, and were reluctant to participate in class discussions. The hybrid virtual course supported by ubiquitous tools and web services was a success with positive student feedbacks. Students were satisfied with locating their technical tools to fulfill course requirements in comparison to spending time and resources on course specific technology.

VIII. Conclusion

The availability of ubiquitous tools and web services present opportunities and challenges for IT education. The availability of these technical resources to users at low or no cost permits the delivery of IT education independent of campus technical support. The revised instructional approach supports continuous learning environment and potentially resolves some scheduling, equipment and facility problems. On the other hand, it requires the instructor to develop better understanding on tools and web services not traditional adopted for instructional supports. The instructor must also redesign the learning process, and place higher emphasis on learning outcomes instead of focusing on learning activities. An interesting research question that deserves attention was whether efforts should be divert from the further development of sophisticated tools, to research on improving and linking the capabilities of ubiquitous tools and web services that received overwhelming acceptance from the end users. Is an universal tool that can potentially used for many applications more valuable that ubiquitous tools that many people want to use?

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