

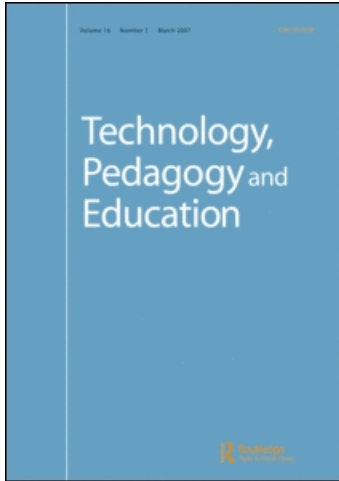
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Teaching with the internet

Siva Kumari ^a

^a Rice University, Houston, USA

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Teaching with the Internet

SIVA KUMARI

Rice University, Houston, USA

ABSTRACT As information technologies become increasingly accessible resources for K-12 educators to use in their teaching activities, meaningful integration of these resources into learning activities becomes an important issue for pre-service and in-service teacher education. Teachers will need to confront the vast amount of information that the Internet hosts and develop the ability to harness this resource purposefully and productively in their classrooms. Once they acquire the initial set of skills that are required to navigate and consume Internet resources, they will need to attend to issues relating to effective means of using them with their students. This article discusses lesson plans created by teachers specifically to integrate Internet resources into learning activities. The lesson plans discussed here are an outcome of two funded projects described briefly in the article. A goal of both projects was to equip teachers to independently author customized materials that would address their individual teaching needs. These lessons are discussed from the perspective of the instructional strategy employed by the teacher, the stated educational intent and the creative use of readily available Internet resources in learning activities.

Introduction

An overwhelming body of literature in the information technology arena attests to the viability of the Internet as a resource that can revitalize teaching and learning in the K-12 community (that is, pre-college education, from Kindergarten to 12th grade). These reports come from a cross-section of stakeholders in K-12 education: teachers, educators, students, parents and public officials. The predominant call is to explore the vast resources of this medium for education and to create models of integration for teachers to effectively and efficiently harness the potential of this medium. As we progress from an initial awe when first confronted with this medium and transcend the novelty phase, we ought to concern ourselves with critically examining how we can enable teachers to use it in their everyday teaching and learning activities. This article attempts to analyze some of the

successful instructional strategies used by K-12 teachers in integrating Web resources into learning activities.

Why do we Need to Attend to the Issue of Integrating Internet Resources?

As more schools attain Internet access, educators will need to create models that can be used in professional development programs to teach the process and confront issues related to integration of these informational resources into usable lesson activities. The continuous and steady increase in the number of schools connected to the Internet demands that we address issues relating to effective practices of integration into learning activities. As excerpted below, statistics provided by the United States (US) Department of Educational Technology (DET, 1997) provide evidence of a steady increase in the percentage of connected schools from 1994-96:

School access to the Internet has increased by 15 percentage points for the second consecutive year. In 1994, when data were first collected, 35 percent of public schools were connected to the Internet (Table I). This increased to 50 percent by 1995 and rose again in 1996 to the current level (65%).

In a report that addresses issues relating to preparing teachers for the twenty-first century, the National Council for Accreditation of Teacher Education (NCATE) in the US calls for a fundamental rethinking of traditional resources available to K-12 teachers:

Dependence on a single source of information, typically a textbook, must give way to using a variety of information sources. As new technologies become more readily available and less expensive, they will likely serve as a catalyst for ensuring that new approaches to teaching gain a firm foothold in schools. (NCATE, 1997)

The current US administration calls for every school and library to be connected to the Internet by the year 2000. This national focus also validates the need to contend with this medium as a resource that will be increasingly available to K-12 teachers.

One can safely predict, given the current state of growth in access and the national and international attention focused on this issue, that larger numbers of teachers will grapple with effective ways of integrating the Internet into the classroom.

Integrating Virtual Information Resources

The Internet has profoundly changed the way we perceive and interact with information in our everyday lives. It is quickly reshaping the ways we relate to one another, communicate, educate and collaborate. It is also modifying

our modes of accessing information, deciphering, filtering and recompiling it for practical use.

In an educational setting, the Internet enables teachers to connect to information resources far beyond the physical confines of the classroom, requiring a rethinking of the teaching and learning that occur within these walls. A computer or a number of computers connected to the Internet can bring the virtual world into the walls of the classroom, thus exponentially increasing the knowledge base available for practical use in teaching and learning. However, none of these worthwhile possibilities will occur magically or instantaneously by placing a computer in the classroom. Teachers need to be educated to use, mine and configure this information resource and to rethink teaching and learning with the availability of these new technologies. Kellnar (1998) calls for fundamental shifts in relation to integration:

This technological revolution, centering on information technology, is often interpreted as the beginning of a knowledge society, and ascribes education a central role in every aspect of life. The Great Transformation poses tremendous challenges to education to rethink its basic tenets, to deploy new technologies in creative and productive ways, and to restructure education in light of the metamorphosis we are now undergoing. (p. 103)

Literature reviews reveal a number of case studies, project reports and individual teacher experiences relating to the use of the Internet in K-12 education. Practitioner journals are replete with how-to articles about using the Internet, participation in on-line projects and creating web materials for use in the classroom. Multitudes of on-line and paper-based resources provide links to on-line materials for almost every subject in the K-12 curriculum. The potential of the Internet is repeatedly emphasized, explored and sold to the educator. Clearly, there is an overwhelming amount of practical literature available to the teacher interested in using the Internet in the classroom. However, there is very little material that emphasizes effective instructional strategies that are needed in creating on-line learning environments. Even more so, there is very little that discusses the elements of effective integration while providing examples.

Teachers currently using the Internet, the pioneers and many more that follow will face important pedagogical considerations when creating lessons using this medium. "The need for research on effective practices for educationally relevant uses of distributed Internet resources is increasingly evident as teachers, administrators, and students struggle with new ways of teaching and learning in technologically intensive environments" (Battle & Hawkins, 1996, p. 339).

It is becoming increasingly apparent that these networks are here to stay and that their use in the K-12 classroom will continue. This increasing use necessitates attention to the changing nature of learning and processing

skills that are requisite of “learners of today and the workers of tomorrow” (Lappalainen & Olkinuora, 1995). Kellnar (1998) has this to say about a new kind of literacy that is required:

Multimedia literacy also envisages new modes of collaborative work on research projects or web sites, new forms of student/teacher participation and interaction, and new pedagogical uses for the new technologies which may appear exotic at present, but which will become increasingly commonplace in the future and will force a rethinking of education. (p. 118)

In this article, I will analyze lesson plans created by teachers primarily to integrate the Internet into their classroom activities. These lessons are a result of two projects whose focus was to train K-12 teachers to integrate the Internet into their curriculum and create on-line lesson activities. The article starts with a brief description of the two projects followed by a discussion of the educational and instructional strategies used in the lesson plans. McDougall & Squires (1997) provide a comprehensive framework for creation and evaluation of professional development programs and ask us to consider five foci: skills in using particular software applications, integration of IT (Information Technology) into existing curricula, IT-related changes in curricula, and changes in teacher roles and underpinning educational theories. The teachers trained through these two projects underwent training programs that included all aspects of the five foci that are described above although the “underpinning educational theories” were not mentioned by name attention (Kumari, 1997).

Brief Description of the Projects

The OWLink Project

Initiated in June of 1994, this project links five diverse K-12 schools in the Texas area to each other and to Rice University via an ATM (Asynchronous Transfer Mode) based fiber-optic network that allows high-speed and high-quality two-way video/audio interactions. Each of the classrooms is equipped with 12 multimedia computers connected to the Internet via high-bandwidth (ATM) access. Twelve teachers were trained during the summer of 1996 in the use of these electronic teaching classrooms termed *electronic studios*, the Internet and the operation of the teledistance equipment. As part of the training session, teachers were asked to collaborate with each other and create on-line lessons that integrate the Internet.

The 2-week training program resulted in teachers producing a portfolio which included Internet-based curricular units. Teachers from the diverse sites collaborated to produce interdisciplinary units that allow students to extend their everyday educational experiences and engage in learning

activities that include: simultaneous exploration of the Internet, exchange of Internet resources, data, production of material, collaborative learning and peer-review processes.

The GirlTECH Project

Funded by the National Science Foundation (NSF), this project started in the summer of 1995. Twenty mathematics and science teachers were provided with an IBM Thinkpad® computer and Internet access through Rice University. In a 4-week training program, teachers learned to use the Internet and create on-line lesson plans. They were trained in the mechanics of producing lessons for the Web, i.e. HTML (HyperText Markup Language), graphic manipulation, maintenance of web space, FTP (File Transfer Protocol), Telnet, etc. In contrast to the OWLink project whose teachers returned to classrooms with Internet-ready multimedia computers for students to use, some GirlTECH teachers returned to classrooms where the computer provided by the project was the only one available for the students to access the Internet. This constraint was very much at the forefront of discussions as the teachers created lessons for use with their students. Consequently, GirlTECH teachers created lessons which fulfilled the needs of a one-computer classroom rather than for groups of students with simultaneous Internet access.

Integrating the Internet into Classroom Activities

When introduced to the Internet, teachers from both projects were simultaneously overwhelmed and excited by the tremendous educational potential of the Web. The breadth, span and scope of the educational resources at their disposal astonished them. They were also overwhelmed by the complexity of creating web materials, navigating the Internet and the process of integration. From a mechanical standpoint, these teachers had to deal with text-based editors to create their pages and had to learn raw HTML code. The continuing refinement of WYISYG (What You See is What You Get) HTML editors has since then minimized this time-consuming process for professional development programs.

After overcoming the initial intimidation of navigating the Web, teachers attended to issues relating to their lesson plan portfolio. In doing so, they targeted specific and immediate classroom needs and were concerned with customizing the Web to address those needs. Teachers chose fundamental concepts or concepts that they thought students often had the most difficulty with as a basis for their exploration and experimentation with the Internet. In discussing issues relating to effective teacher training practices, Davis (1995) contends that one such issue is “answering needs” where she elaborates that “answering relevant and pressing needs for

teachers and learners is probably the only way in which Telematics will be established in education” (p. 207). In the projects discussed here, that notion was central to the integration of technology into teaching and learning. Asking teachers to choose topics that were of utmost relevance to them ensured that the teachers would continue to work with these lesson plans in the classroom. Two years later there is evidence that the teachers continue to refine the lesson plans that they created in these projects. As Davis states in discussing “establishing new practices”, another issue that she contends as critical to training and implementation: “if Telematics is to become an on-going activity rather than an occasional ‘binge’, then participants need to make it a part of their routine. New practices in relation to teaching and learning also need to be established, so purposes must be very clear and relate to all participants’ agendas” (p. 207).

Oliva (1992) defines an instructional strategy as “methods, procedures, and techniques the teacher uses to present the subject matter to students and to bring about effective outcomes” (p. 403). Teachers chose instructional strategies to answer the needs of their students, the school, state-mandated curriculum and instructional problem areas especially related to fundamental concepts. In addition to applying these strategies, however, they used the opportunity to rethink their instructional strategies in the light of the educational resources available on the Internet. In creating their lessons, teachers capitalized on the following characteristics of the Internet:

- electronic information source with access to worldwide databases of information;
- interactive and easy-to-use information exchange medium;
- lesson presentation tool easily accessible by students with access to the Internet;
- a tool to facilitate collaborative learning projects;
- a means to strengthen learning through practice with real problems and data;
- an avenue to publish electronic portfolios of their teaching activities;
- a means of communication and collaboration with colleagues beyond the walls of their individual classrooms.

Teachers discussed their roles as facilitators in teaching with these electronic environments. They identified a need for a new form of teacher-student relationships. They viewed the Internet as a dynamic teaching and learning medium with which to facilitate learning, enhance comprehension and provide rich contextual learning environments for their students. Teachers immediately recognized that students might be more familiar and adept with these advanced technologies than they themselves were and sought to take advantage of these student skills to rethink the teaching process as a collaborative journey. Teachers started to think of themselves as directors of student learning, providing guidelines and pathways for students to attempt in the learning process. Students were

expected to take an active part in exploring these pathways, venturing down new ones and taking responsibility for their learning.

Constructivist philosophies held by teachers took precedence over more traditional approaches when integrating the Internet. Teachers with more essentialist philosophies used this medium quite differently than those with interdisciplinary and student-centered approaches. Those teachers with constructivist teaching styles adapted much more easily to the Internet and were able to immediately identify enriching learning opportunities. As discussed below, those with more traditional approaches found it difficult to create lessons that fully explored this hyperlinked environment.

Interdisciplinary Learning Approaches

In order to fulfil the goals of this experimental teledistance project, teachers in the OWLink project whose lessons are discussed in this section needed to collaborate with their colleagues to teach across subject areas and grade levels. Since collaboration among teachers was a primary goal of the project, the lesson plans provide evidence of interesting interdisciplinary projects. These lesson plans were created to link high school students with students from the third through eighth grade in the exploration of concepts using the Internet as a medium for presentation, gathering data and exchanging data. They also serve as examples of ways to foster information exchange among students and to trade and conduct collaborative work across distances. They take into account the more powerful features of the Internet which enable students to explore the concept in a multitude of ways, collect relevant data and critically analyze it from a given perspective.

Note: The subheadings that denote specific lesson plans represent the title that the teachers created for that lesson.

The Golden Ratio (<http://outreach.rice.edu/~winkler/goldenratio.html>)

A model example of information exchange and collaborative learning using the Internet, this lesson enables students of different age levels to explore the concept of the *Golden Ratio* across several curricular disciplines. The teacher researched Internet sites in advance for relevance and linked them in her on-line lesson plan to enable students to research the *Golden Ratio* in an effective way. Prior research of sites that contain relevant information was one strategy that the teachers felt strongly about. This strategy seemed to ensure productive and guided exploration as opposed to exposing students to the possibility of surfing the Internet without learning.

Students from three schools, who were separated physically but connected via the Internet and the teledistance system, used this lesson plan and calculated their body measurements. Cumulative data from each site was exchanged through the use of a web-based form that forwarded the data to the teacher. The students then compared the three school means to the

Golden Ratio. The different age groups made interesting discoveries about the concept, leading to a discussion of the concept among the students at the various sites.

In addition to collecting data and fostering collaborative exploration, this Internet lesson activity enables the exploration of the concept across the disciplines of architecture, mathematics and science. By linking relevant information sources and providing opportunities for students to explore this concept further, the teacher was able to foster extended exploration. Immediate application and verification of the concept in practice, especially across age levels, and the collection and comparison of data led to the creation of a rich context within which to situate the learning and exploration of this concept.

Golden rabbit stew with honey, flowers, and music
(<http://outreach.rice.edu/~mkendall/Lessons/rabbitstew.html>)

This lesson capitalizes on the wealth of mathematical resources available on the Web by asking students to explore the interdisciplinary relationships of the Fibonacci numbers to not only mathematics, the subject where the concept is traditionally introduced in the school curriculum, but to nature, art and music as well. The teacher asks students to explore the mathematical concept by linking relevant sites that elaborate upon Fibonacci numbers across the disciplines. Students are then asked to apply the knowledge they gained by creating examples of their own. One of the valuable features of this lesson is the annotations that the teacher provides for each of the resources that he/she links, thus directing the students to the educational experience they need to attend to within these resources.

Mandalas: Geometric link between medicine and history
(<http://www.rice.edu/armadillo/Schools/HSHP/mandalas.html>)

Encouraging students in high school geometry courses to relate the geometrical concept of symmetry to ancient cultures and modern medicine, this lesson embodies activities, instructions and a compilation of resources for both the teacher and the student to use. The teacher creatively links together resources on the Internet to enable students to pursue project-oriented work including a site where the student can create a mandala. The comprehensive resources linked together within this framework enable one to explore the properties of mandalas across the disciplines of medicine, science, history and culture. Built into the lesson plans are directions for students to access sites with descriptions and images of mandalas, to create interactive mandalas on the Internet and to use paint programs to create their own personal mandalas. The lesson also enables students to learn more about the mandalas in relation to the ancient Aztec and East Indian cultures that use mandalas in their architectural and religious symbols. The teacher provides them with additional information

about the use of mandalas in modern medicine, thus tying the historical use to the continuing modern use. This lesson serves as a good example of how to provide opportunities for the student to study the geometrical concepts in historical and cultural contexts. The Internet is used as a tool to create an environment within which learners can form connections among subject areas through guided exploration.

Dede (1996), in discussing hypertextual environments, states that “the emerging literacy we all must master requires diving into a sea of information and immersing ourselves in data in order to harvest patterns of knowledge. As educators, understanding how to structure learning experiences to make such immersion possible is the core of the new rhetoric” (p. 25). The lesson plans described in the above section serve as examples of the need on the part of the teacher to research information and ‘structure’ it so that the learners ‘dive’ into a meaningful ‘sea of information’ where they immerse themselves in ‘data’ to ‘harvest’ knowledge. Directives from the teacher about the ‘kind of information’ that needs attending to is critical in integrating the Internet to create educative experiences and in minimizing the likelihood of mis-educative experiences.

Problem-based Learning Approaches

Discussed in this section are lesson activities that use an approach emphasizing connections between concepts and the application of knowledge to real-life problems. Teachers using the Internet were able to provide learners with a wealth of contextual opportunities within which to explore concepts and study examples of application of the concept. The Internet provides a wealth of information for teachers and students to use in this manner. Teachers and students can access information to explore a concept in real life, download this information, adapt, modify and process it to answer different problems:

The new technology will transform the role of the teacher as thoroughly as did the introduction of print textbooks. More than in the past teachers must become advisors to student inquiries, helping them to frame questions for productive investigation, directing them toward information and interpretive sources, helping them, to judge the quality of information they obtain and coaching them in ways to present their findings effectively to others. (NCATE, 1997)

Described below are a few lesson plans that use a problem-based approach in mathematics. These have been further subdivided into three curricular perspectives as outlined by McNeil (1995).

Utilitarian Perspective

This perspective proposes that student learning should relate to real-world problems and that students should be challenged to solve these problems. The lessons described below test the capabilities of the Internet as a resource to solve real-world problems.

A functional housing market

(<http://www.crpc.rice.edu/CRPC/GT/sboone/Lessons/Titles/lphouse.html>)

Students are asked to gather data from local real-estate web sites to predict housing market prices. While doing so, they explore and apply the concept of linear equations. Students are required to gather, manipulate and process data and information to predict the per square foot market prices in their own neighborhood using the 'line of best fit' method, a mathematical concept taught in middle school. The teacher creatively links real-estate sites in this lesson plan while providing explicit directions for students that will enable them to gain the particular skills that he/she intends to achieve with this lesson. By exploring the concept in real-world contexts, the students are able to apply solutions to problems that are not academically manufactured. They are required to confront and deal with real-world data sources. Additionally, the teacher offers suggestions to other teachers and students on how to extend these activities to group-based learning and to other contexts so students may obtain a national/international perspective.

Pop clock (<http://www.crpc.rice.edu/CRPC/GT/sboone/Lessons/Titles/popclock.html>)

This lesson plan requires students to collect current data from the US Census Bureau and use it to predict future population trends. Students compare their predictions to those of the experts. The teacher connects the students to databases of information, asking them to retrieve, analyze and re-evaluate data in order to answer interesting questions about societal conditions. This lesson serves as a model of integration for several reasons. It requires students to connect with real-world statistics and data. Furthermore, students are asked to explore the implications of the data for real-world societal conditions.

The lesson plans described above serve as models of creating an on-line environment within which students can create strategies to solve real-world problems with maximum efficiency using real-world data. "The teacher provides a set of group structures that enables students to work out a problem or undertake a task, search for strategies on their own, and evaluate their solutions" (Harasim et al, 1995, p. 174).

Academic Perspective

McNeil (1995) contends that this curricular perspective intends to present the students with an authentic view of the subject matter as held by experts in the field. The lesson plans outlined below use this instructional perspective in integrating the Internet into teaching activities.

Hysterical math

(<http://www.ruf.rice.edu/~mkendall/Lessons/hystericalmath.html>)

The teacher links web sites that present the history of mathematics and weaves them into a creative lesson idea. The intent is to provide students with profiles of famous mathematicians, using resources that reside on the Web. The lesson provides students with opportunities to foster a deep understanding of the mathematician of their choice via the wealth of biographical material available about mathematicians on the Internet. Following the initial on-line exploration, students are asked to make presentations to their peers, demonstrating a synthesis of their research on the mathematician. This goal-oriented research process is yet another strategy that allows productive and constructive exploration on the Web.

Eratosthenes finds diameter of earth!

(<http://math.rice.edu/~ddonovan/Lessons/eratos.html>)

This lesson takes an academic perspective by asking students to perform Eratosthenes's original experiment, research the concept and complete email-based activities to gain practical experiences with the concept. This lesson integrates theory and application of the concept via the Internet.

Earthquaked!! (<http://math.rice.edu/~jrenza/Lessons/earthquake.html>)

Students are given instructions on how to calculate the Richter Scale in this lesson. The teacher links students to experts' resources in higher education that maintain information on earthquakes and the Richter Scale. Students are asked to gather information about earthquakes and study the methodology for measuring earthquakes or emulate the process followed by experts. The teacher uses the Internet to provide a structured experience for students to understand the concept and asks them to compare their understanding to that of experts.

"A learner will be able to perceive how the experts in the subject who prepared the material think about and organize the material" (Harasim et al, 1995, pp. 252-253). The lesson plans discussed in the section above attempt to do just that. They prepare a context for study, connect the learner to material where the students can delve into expert sources to further explore the concept and make comparisons between their experience and that of experts.

Student-Centered Perspective

This approach suggests that the teacher activate student interest and motivation about the topic to be learned and lead them into further exploration that builds on these personal interests. The following lesson plans take this perspective and use the Internet as a means to create activities that are highly relevant to students. These innovative mathematics and science lessons use entertainment sites as resources and harness them for educational exploration.

I feel the need for speed

(<http://www.crpc.rice.edu/CRPC/GT/jamerson/Lessons/roller.html>)

This lesson plan allows students to explore the concepts of speed, velocity, acceleration and inertia of moving objects by linking to sites with rollercoasters. After exploring these concepts, students are required to produce answers to questions outlined by the teacher.

Calculating a car payment

(<http://www.crpc.rice.edu/CRPC/GT/bchristo/lessons/carpaymt.html>)

The teacher exploits a topic that is highly relevant to teenagers in the US: the need to buy a car. He/she uses this as an opportunity to connect the student to data sources on the Internet that have car prices, such as used car sales. From these data sources, students are asked to gather the price of their dream car and calculate car payments. In the process, the students employ and practice applying formulas containing fractions and exponents to work on a real-world problem that many of them will soon face.

Instructional Systems Approach

From the analysis thus far, it can be clearly derived that the integration of the Internet can result in powerful combinations of connections to data, exploration, synthesis and production of knowledge. However, the integration can also take the more traditional teaching approach where the teacher is in control and creates objective-driven instruction. In this model the teacher is the knowledge-giver and the student is the recipient. This traditional approach requires less creativity on the part of the teacher in using the Web and lends itself to relatively less rethinking on the part of the teacher. Clearly, a good amount of instruction in outcome-based education uses an objective-based model of teaching and is needed in classrooms before higher-level objectives are attempted. This section deals with some of the lessons that use the Internet to accomplish this strategy.

Using Standard Deviation

(<http://www.crpc.rice.edu/CRPC/GT/bchristo/lessons/StanDev1.html>)

This lesson asks students to download weather data to apply the standard deviation formula. The students use real sets of data to calculate the standard deviation. This lesson uses the Internet for a very fundamental use: the ability to connect to real data.

A bit of computer history

(<http://www.crpc.rice.edu/CRPC/GT/cjones/lessons/lesson4.html>)

This lesson links students to a web site that hosts computer history and asks them to answer questions outlined in the lesson plan. Future expansions of this lesson plan can achieve broader educational objectives by including activities that require the learner to interact with the information and make the knowledge their own, rather than gathering material on the Web and rewriting the facts.

Conclusion

“Computerized electronic technology makes possible not only the wide and rapid distribution of information but its manipulation, analysis, synthesis and recombination as well. Through these operations, new knowledge is created that helps us understand ourselves and our world in new ways” (Gibbon, 1987, p. 2). The lesson plans discussed above take advantage of the Internet to provide students with learning environments to do just this. Students in the process of interacting and using this medium learn valuable skills needed in the information age. They learn how to read visual images and information, judge the value of data, download information and process it to suit their needs. Teachers whose lesson plans are represented above are truly re-envisioning the way they can teach concepts in light of this information resource. They harness the potential of the medium as an educational resource with unlimited bounds and customize it to answer their teaching needs. Scrimshaw (1997), in discussing the teacher’s redefined role in using computers, concludes that “teachers need to teach the process of learning rather than its products. The conventional learning skills, such as locating, collating and summarising information, and identifying connections and contradictions within a body of information all need to be explicitly moved to the centre of the classroom curriculum” (p. 112). Teachers in these two projects have provided evidence of how these processes can be accomplished using the Internet.

There is evidence that exposure to the Internet has caused a paradigm shift in some of these teachers as evidenced in their lesson plans. They are not restricted to textbooks nor do they have to distribute information to their students in previously standard formats (paper and worksheets). They

expose their students to a world of electronic learning opportunities and prepare them for learning in these information-rich contexts.

Although access to the Internet in the classroom is not a norm in today's schools, we have signs indicating that this is expected to change. In this light, it is informative to study and analyze these pockets of successful experimentation. Training teachers in technical skills to use the Internet is clearly critical, but it is equally critical to challenge them to rethink and re-envision teaching and learning with this medium. Interdisciplinary curricular, collaborative exploration and the production of evidence that reflects learning are central themes discussed in this article that have been successfully used by teachers in integrating the Internet. These processes require students to acquire important skills: evaluating, processing, discussing and presenting electronic information. Changes in instruction, changes in curricular instances and changes in teaching with technologies are all evident in these lessons (Gibbon, 1987). "The most obvious benefit of the electronic classroom is that it achieves what progressive educators could only dream of: a union of work and play ... There is no certainty that the electronic classroom will actually fulfill this promise, but it is this hope that makes the realization so attractive" (Ravitch, 1987, p. 28).

The teachers whose lesson plans were discussed here engaged their students in meaningful and highly relevant learning activities. The Internet is serving as a means to engage students and teachers as equal partners in an educational journey in these electronic environments. It is also serving as an information resource that the student can actively interact with to learn concepts addressed in the school curriculum. Individualized lessons and student-centered learning are made possible by these environments, for which teachers have to invest heavily in time and training, issues that warrant further exploration in and of themselves. Once created, however, these lessons can supplement the role of the teacher as the content provider and allow him/her to engage students in the exciting learning activities that reside on the Web. The teacher is then free to function in a modified role in relation to his/her students, as a conductor of learning activities, a mediator in information processing and the guide in problem-solving activities.

Correspondence

Dr Siva Kumari, 3915 Marlowe, Houston, TX 77005, USA (siva@uh.edu).

References

- Battle, R. & Hawkins, I. (1996) A study of emerging teacher practices in Internet-based lesson plan development, *Journal of Science Education and Technology*, 5, pp. 321-342.

- Davis, N. (1995) Distance education with telematics for distance educators, *International Journal of Educational Telecommunications*, 1(2/3), pp. 199-211.
- Dede, C. (1996) Distance learning – distributed learning: Making the transformation, *Learning and Leading with Technology*, 23(7) (April), pp. 25-30.
- Department of Educational Technology (1997) *Advanced Telecommunications in U.S. Public Elementary and Secondary Schools*, Fall 1996 [on-line]. Available at: <http://nces.ed.gov/pubs/97944.html>
- Gibbon, S. (1987) Learning and instruction in the information age, in M. A. White (Ed.) *What Curriculum for the Information Age?* Hillsdale: Lawrence Erlbaum Associates.
- Harasim, L., Hiltz, S. R., Teles, L. & Turoff, M. (1995) *Learning Networks: a field guide to teaching and learning on-line*. Cambridge: MIT Press.
- Kellnar, D. (1998) Multiple literacies and critical pedagogy in a multicultural society, *Educational Theory*, 48, pp. 103-122.
- Kumari, S. (1997) Technology training model for inservice teachers to integrate information technologies, in J. D. Price, K. Rosa, S. McNeil & J. Willis (Eds) *The Proceedings of SITE 97 – Eighth International Conference of the Society for Information Technology and Teacher Education*, Orlando, 1 – 5 April. Charlottesville: Association for the Advancement of Computing in Education. Also available on-line at: <http://ctl.rice.edu/Publications/>
- Lappalainen, M. & Olkinuora, E. (1995) Challenges for learning skills now and in the future [on-line]. Available at: <http://www.tkk.utu.fi/~arileino/olkinuora.html>
- McDougall, A. & Squires, D. (1997) A framework for reviewing teacher professional development programmes in information technology, *Journal of Information Technology and Teacher Education*, 6, pp. 115-126. Available on-line at: <http://www.triangle.co.uk/jit/>
- McNeil, J. (1995) *Curriculum: the teacher's initiative*. New Jersey: Prentice-Hall.
- National Council for Accreditation of Teacher Education (1997) *Technology and the new professional teacher: preparing for the 21st Century Classroom* [on-line]. Available at: <http://www.ncate.org/projects/tech/TECH.HTM>
- Oliva, P. F. (1992) *Developing the Curriculum*. New York: Harper Collins.
- Ravitch, D. (1987) Technology and the curriculum: promise and peril, in M. A. White (Ed.) *What Curriculum for the Information Age?* Hillsdale: Lawrence Erlbaum Associates.
- Scrimshaw, P. (1997) Computers and the teacher's role, in B. Somekh & N. Davis (Eds) *Using Information Technology Effectively in Teaching and Learning: studies in pre-service and in-service teacher education*. London: Routledge.