Constructivist Approach Towards Web-Based Learning Among Polytechnic Lecturers

by

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ABSTRACT

The Information and Communication technology such as the WWW presents itself as a medium for channeling creative and collaborative learning. The extraordinary growth of the WWW necessitates engineering educators to look into their pedagogic approach to capture the ever-expanding knowledge and technological advancement in their area of expertise. This study attempts to look into the way the constructivist approach is related to the adoption of the WWW. The target population for this study was engineering lecturers from Polytechnics in Malaysia. Stratified sampling is applied to ensure that representative samples from the respective engineering departments are obtained in this study, namely the Civil Engineering, the Mechanical Engineering and the Electrical Engineering Department. The sampling size for this study was 500 engineering lecturers and the selection was based on the table of random numbers. The researcher visited all Polytechnics in Malaysia to conduct the questionnaire research except Sabah and Sarawak. The response rate for this study was 75.6%. The usage of the Web-based learning was significantly related to the constructivist approach ($\underline{r} = 0.591$, $\underline{p} < 0.05$), and a correlation analysis indicated that it explained 35% variance of the dependent variable i.e. the constructivist approach. This study has resulted in the formulation of a simple model linking the adoption of the Web-based learning in relation with the constructivist approach.

INTRODUCTION

In tandem with the need for adopting the WWW into engineering education, the pedagogic approach of constructivism seems applicable and appropriate, where learners are able to build knowledge and meanings through the vast repository network of the WWW information. The constructivist approach postulated by Vygotsky (1978) defined learning as a social entity and supported the learner-centered approach where teachers or lecturers provide the guidance and acting as facilitators in the classroom. The reason computer Web-based learning was chosen as the dependent variable, instead of the traditional coursework, such as lecture, is that the growth of the Internet especially the World Wide Web has been phenomenal and a fast growing field.

It is important to determine if the availability and use of WWW technology in classrooms can encourage teachers' demonstration of constructivist behaviors in their classrooms. This exploratory study examines the relationship between teachers' use of the WWW technology in their classrooms and their pedagogic approach of constructivism.

Constructivism presents possibilities for classroom strategies that vary dramatically from those used in the traditional information-transfer model of instruction and presents possibilities for producing students who possess the skills necessary for work and life-long learning (Brooks & Brooks, 1999; Iran-Nejad, 1995; Bradshaw, 1997; Windschitl, 1999).

The overriding goal of the constructivist educator is to stimulate thinking in learners that results in meaningful learning, deeper understanding and transfer of learning to real world contexts. To accomplish this goal, a constructivist framework leads teachers to incorporate strategies that encourage knowledge construction through primarily social learning processes, in which students develop their own understanding through interactions with peers and the teacher. In addition, in order to make manifest and link new knowledge to learners' current understanding, the constructivist teacher selects authentic tasks and uses more ill-defined problems and higher order questions. A significant problem tackled by small groups of students promotes involvement, curiosity, and heightened motivation.

Vygotsky mentioned a word without meaning is not a word. Culture is particularly relevant in determining the meaning of events, people and things. According to Vygotsky, each learning function in cultural development occurs twice, on the social level and then on the individual level. All the two levels are originating through actual relationships with other humans.

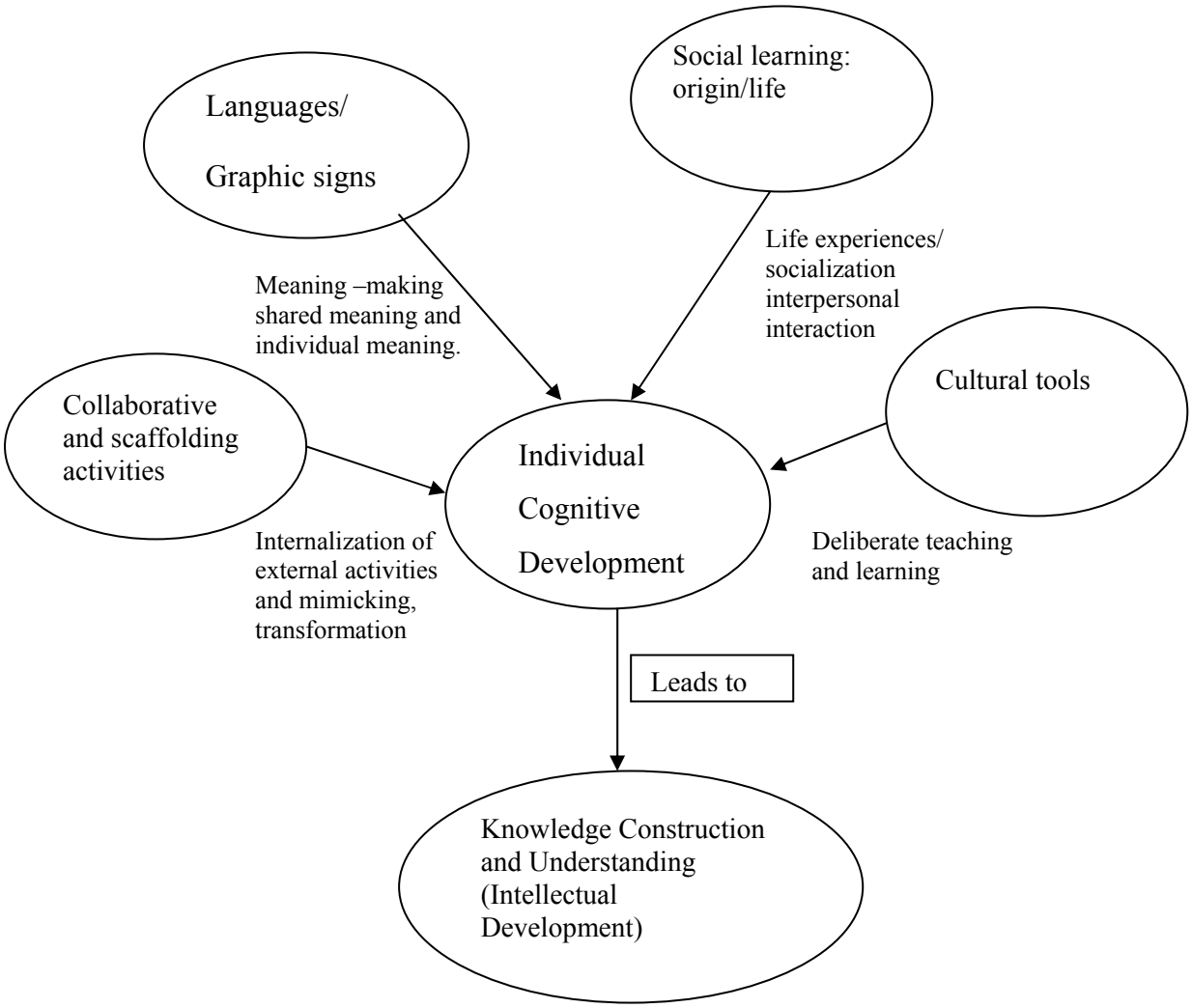

Figure 1: Constructivist Model of Social Learning

The educators in Springfield School District embarked an online educational project known as LINCOLN (Living In the New Computer- Orientated Learning 'Nvironment) that has resulted in higher levels of student learning and engagement (Holinga, 1999). The project has five components:

1. A curriculum that has been structured as interdisciplinary units of study.
2. Assessment that based on Illinois and national learning standards.
3. Collegial teaching relationships that create effective support networks.
4. Redefined teachers' role as instructional facilitators.
5. Considerable parental involvement in the educational process.

According to Holinga, project LINCOLN is a constructivist model of education: teachers work as facilitators and coaches, guiding students as they gather information and present it to their peers and teacher. Project LINCOLN's success has been validated by the standardized test scores of students in participating classroom which are higher than the scores of cohort of peer students in non-participating classroom (Holinga, 1999).

Middleton (1998) reported that when teachers used higher levels of technology for their instruction tasks, their students had significantly higher scores on the achievement test than students whose teachers used little or no technology in class. Similarly, Wenglinsky (1998) found that eight graders whose teachers used computers associated with higher order thinking performed better on National Assessment of Educational Practices (NAEP) than the performances of students whose teachers did not. Moursund (1999) reiterated that integration of IT into education would mean that students and teachers had routine access to these facilities, and that a technical support staff was in place to provide a high quality and timely support.

Much cognitive science research has been used to support a new model of learning. This most promising new model is called the Constructivist Learning Model (CLM) (Yager, 1991) brings theory, practice, and modeling together in an integrated manner to help teachers realize the connections. Every science teacher needs such an experience if the visions comprising the NSES are to be realized generally by 2005. Students who appear to possess certain knowledge, as measured by standardized tests, are often not able to apply what they know in even slightly modified contexts (Yager, 1991).

The Web has provided an effective means to implement the constructivist approach, which would be difficult with other media (Driscoll, 1994). Specifically, communication technologies have the capacity to provide an interactive, and collaborative environment that can support learning and teaching through constructivism. Thus, the research framework is based upon the relationship between the adoption of the WWW and the constructivist approach to supplement the teaching-learning tasks by engineering lecturers in Polytechnics.

Within the confines of Web based learning, engineering lecturers must capitalise on the constructive nature of inquiry that the Web can support. Constructivist learning is based on activities that are student-initiated, meaningful, and complex where inquiry is a good example of such a learning process. Engineering lecturers and students should reflect together on what constitutes meaningful inquiry questions. Posing questions is a valuable skill and students become more invested in inquiry when they develop the question.

Students should develop their own strategies to gather and interpret evidence. This requires patience on the part of the engineering lecturers. Students should be allowed the flexibility to reframe their inquiry question if data collection indicates their question is unclear or inappropriate (Windschitl, 1998).

The strongest argument for the use of any tool is that it permits activities or insights that could not be realised without it. Inquiry can take place in classroom without technology but it is hardly sufficient. Technology is merely a tool, not an instructional method. Engineering lecturers must believe they can pose meaningful questions and construct knowledge for themselves rather than always accepting predigested information. In conjunction with this, engineering lecturers must help themselves cultivate the values and discipline necessary for independent exploration. All these endeavours form the basic reason to be enthusiastic about the Web support for constructive learning among engineering lecturers.

As the internet and the WWW mature, Polytechnics in Malaysia or other technical institutions will be increasingly challenged to address the educational and training needs of knowledge worker or engineering lecturers in the digital world of education. Engineering lecturers will need to develop learning programs for life long learning, anytime, anywhere learning, and just-in-time work-integrated learning. Education in Malaysia will be challenged to integrate Internet and related technologies into management education in ways that reflect the changes these technologies are forcing into the workplace. Web-based learning and teaching concepts among engineering lecturers in Polytechnics offer one vision for meeting these challenges.

Engineering lecturers in Malaysia are therefore poised to benefit from all the rapid economic and technological expansion of ICT around us. The question worth raising is whether the Malaysian engineering lecturers will have the flexibility, dynamism and adaptability to adjust constantly to the challenges of the rapidly changing technology and the demand of the society. Engineering lecturers must prepare and ready themselves adequately to take advantage of the tremendous ICT prospect for balanced knowledge construction and creation.

Objectives

The general objective of the study was to identify the relationship of the adoption of WWW and its relationship towards the constructivist approach. Specifically it sought to (1) describe the general pattern of usage of the WWW; (2) relate the extent of the WWW usage with the application of the Constructivist approach by engineering lecturers and (3) develop a simple model relating the variables under investigation.

METHODOLOGY

The methodology was targeted at engineering lecturers in Polytechnics as they formed the largest group in Polytechnics and are competently trained in their respective technical disciplines. Engineering lecturers who are technically inclined, may provide the drive in adopting the WWW and changes needed to incorporate it into their learning and teaching tasks, which may also require a different pedagogic approach as that in the constructivist approach.

Stratified sampling is carried out to ensure that each sub-division of the engineering department in the target population is adequately represented in the sample. Stratification will generally increase the accuracy (Stopher & Meyburg, 1979). In this study, a stratified sample size of 500 engineering lecturers from the Polytechnics throughout Malaysia was selected based on Cochran (1977) and Rea and Parker (1997). Altogether, there were 378 usable respondents to the survey which represented a response rate of 75.6 %. Of the total 378 respondents, the composition of these respondents was further categorized into Civil Engineering Department (112 or 29.6 %), Mechanical Engineering Department (126 or 33.4 %) and Electrical Engineering Department (140 or 37.0 %).

The sampling of respondents was systematically conducted through the table of random numbers and a proportionate stratified sampling was adopted so as to ensure a fair representation of lecturers from each of the respective engineering departments namely from the Civil Engineering, the Electrical Engineering and the Mechanical Engineering Departments. The returned rate of 75.6% was considered high as the returned rate for postal survey may be as low as 50% or less (Barnett, 1991). The higher rate of respondents than usual may be due to the diligence of the researcher in conducting the research by dropping off the instruments or questionnaires personally to every Polytechnic in Peninsular Malaysia except for Sabah and Sarawak, where mailed questionnaires were used due to the distance involved. However, the average response rate should not be generalized as they vary from one survey to another.

Reminders for non-respondents were directed to the Heads of Departments as they could coordinate better with the lecturers concerned. Data from the returned questionnaires were analyzed using the SPSS. The statistical procedures employed were descriptive statistics, correlational analysis.

FINDINGS

The general usage pattern of the WWW by lecturers in Polytechnics

The respondents consist of 242 male and 136 female engineering lecturers, with their ages ranging from 20 years old to 53 years old. The mean age from the sample group is 33.0 years old, a relatively young age for the engineering lecturers, considering the fact that lecturers usually retire at 56 years old. Only 26.2 % of the staff posses Masters degrees (99 of them), while 38.4 % or 145 of the respondents are first-degree holders, with the remaining personnel hold diploma in engineering qualification. Most of them (75.0%) taught at Certificate as well as Diploma level courses, ranging from Semester One to Semester Six engineering subjects. A small proportion of the lecturers (25.0%) only taught at certificate level courses, ranging from Semester One to Semester Four. Polytechnics in Malaysia offer certificate level as well as Diploma level courses in engineering and business studies.

Table 1: Working experiences of the engineering lecturers in Polytechnics

Number of years	Frequency	(%)
Low (0 – 4 yrs)	192	50.8
Medium (5 – 9 yrs)	38	10.1
Moderately High (10 – 14 yrs)	98	25.9
High (≥ 15 yrs)	50	13.2

Table 1 indicated that marginally more than 50 % of the engineering lecturers are fairly inexperienced in Polytechnics. They have been working in Polytechnics for not more than 4 years or less. However, there is slightly over a third of the engineering staff having work experiences of 10 years or more in Polytechnics. Overall, there is a good mixture of both experienced as well as new lecturers in the Polytechnics system. The working experiences are evenly distributed, ranging from new recruits in teaching to 30 years of teaching experiences, with a mean value of 7.5 years and standard deviation value of 6.68.

This study also indicated that 73.5 % or 278 of the engineering lecturers surveyed have access to the WWW and further to that, 44.2 % or 167 of them have access to the WWW from home. This represents a fairly high percentage of engineering lecturers who are technology adopters of the WWW, in tandem with the present phenomenal development of the World Wide Web in every facet of society over the last decade. The percentage shown also indicated that Polytechnics are beginning to equip themselves with the online facilities though limited in the unit of computers linked at the present state.

Table 2: Distribution of the respondents on selected personnel variables (n = 378)

	The WWW		
Variables	Users	Non-users	Total
Gender : Male	184	58	242
Female	99	37	136
Educational level:			
Master	88	11	99
Bachelor	108	37	145
Diploma	82	52	134
Department:			
Civil Engineering	78	34	112
Mechanical Engineering	85	41	126
Electrical Engineering	120	20	140

The distribution for gender among the lecturers indicated that there are more male than female lecturers with a proportion of about 2:1. The majority of the staff hold a first degree qualification with a smaller proportion having a second or master degree in their respective field. Of all the males lecturers surveyed, 184 (76.0 %) of the total of 242 are users of the WWW whereas 99 (72.8 %) out of the 136 female lecturers in the survey used the WWW. The number of years of teaching experience ranges from 0 to 30 years, and have a mean and median value of 6.5 and 4.0 years respectively for users. The mean and medium age of non-users have a mean value of 10.1 years of teaching experiences and a median value of 10 years of teaching experiences. Thus, users of the WWW generally consist of the younger group of lecturers in Polytechnics. The majority of engineering lecturers (66.5%) who access to the WWW only do so once weekly or less. About a third of them access to the WWW more than twice per week. There are about 15% of the lecturers who frequently access to the WWW more than three times per week.

Table 20: Relationship between the Adoption of the WWW and the Constructivist Approach

	r	p-value
Adoption Model	.591*	.000

Note: Dependent Variable: Constructivist Approach
Predictor: Adoption of the WWW
Multiple R = .591; R square = .350; R square adjusted = .348
F = 202.238; Sig. F = .000; Total n = 378
* Correlation is significant at the 0.05 level (2-tailed).

This research question is answered with a bivariate regression analysis, a part of analysis in the construction of a mathematical relationship that can be used to explain or predict certain phenomena. The constructivist approach taken by engineering lecturers in Polytechnics is being predicted by the adoption of the WWW in supplementing their teaching tasks. Pearson product moment of correlation is used to indicate the extent of relationship between these two variables.

The Model of Adoption of the WWW was found to correlate with the Constructivist approach of learning ($\underline{r} = 0.591$; $\underline{p} < 0.05$) moderately high. This result indicated that the two variables had a fairly strong relationship and the pedagogical approach of Constructivism was appropriately explained by the adoption of the WWW technology. Resonant with the initial findings, the WWW seemed to lend itself easily to Constructivist approach by providing students with the opportunities to communicate, collaborating with people around the communities and the world, conducting research, and discussing issues and work cooperatively. The WWW remained a technological tool in which the Constructivist approach of learning can be supported by it.

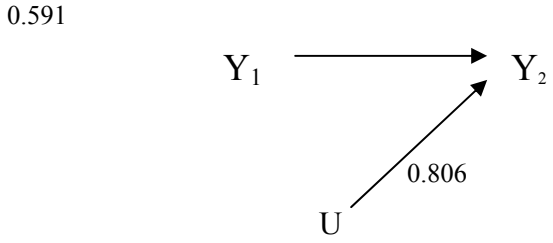

Figure 15: Simple Path Diagram between Model of Adoption of the WWW and the Constructivist Approach

Partition of the total sum of squares and determination of coefficient R^2 for a simple regression.

$$R_o^2{}_{(1)} = \frac{\text{Regression ssq}}{\text{Total ssq}} + \frac{\text{Residual ssq}}{\text{Total ssq}} = 1$$

$$R_o^2{}_{(1)} = (8069.520/23072.371) + (15002.851/23072.371) = 0.35 + 0.65 = 1$$

Therefore; $r_{01} = \sqrt{(0.35)} = 0.591 = p_{01}$

$r_{0U} = \sqrt{(0.65)} = 0.806 = e$

SUMMARY OF THE FINDINGS

Analysis of the respondents for the attributes resulted in the final set of evaluation composing three major areas; the general pattern of the WWW usage, the adoption of the WWW by engineering lecturers and the extent of the constructivist approach to learning and teaching in technology education. The WWW adoption was tied to the constructivist approach in technology education, and portrayed in a simple model.

The Simple Model

The constructivist approach taken by engineering lecturers in Polytechnics is being linked with the adoption of the WWW in supplementing their teaching tasks. The Model of Adoption of the WWW was found to correlate significantly with the constructivist approach of learning. Hence, the formulation of simple model can portray the relationship of each variable under study. The implication for this research will be further discussed and dealt with in the following section.

DISCUSSION

The purpose of this study was to obtain the pattern of WWW usage by engineering lecturers in Polytechnics, and to understand to what extent constructivist approach was related to the adoption of the WWW by engineering lecturers of Polytechnics.

Only recently had it become feasible to consider principles of constructivism within the context of higher education. This was due to advances in communication technologies resulting in an effective means to implement the constructivist approach in the classroom, which would be difficult to implement with other media or means. Specifically, the WWW technologies had the capacity to provide an interactive medium that can support instructional methods required to facilitate the constructivist approach. For these reasons, constructivism had become a popular epistemological approach for many technical educators in the developed countries who were using technology-mediated learning such as the WWW. In agreement with the constructivist approach, instructional strategies might include exploration of multiple and differing perspectives, general and specific content problem-solving processes, and using a random access strategies instruction advocated by Spiro et al. (1990). McManus (1996) cited random access instruction in the use of the World Wide Web and cross-links that "take the learner through the same information several times and from several directions". This enabled the learner to explore multiple routes through the same content thereby reinforcing cognitive construction.

Not surprisingly, educational research revealed that the new constructivist learning approach is not prescriptive, neither dictating classroom structure nor teaching technique. It did explicitly state that conceptual change was the key to cognitive growth and development, and thus conceptual change became an essential quest for the lecturer's professional action. The precise nature of that endeavour was derived from the lecturer's negotiations with the learners in the incorporation of new technology namely the WWW.

It is for this reason that the Web has challenged the traditional strict curriculum control where learners are at the mercy of teaching and linearly correlated with the syllabi. The Web can foster at least three significant aspects of learning: independent learning, creative learning and flexible learning.

The technologies that encouraged interactivity such as the WWW, multimedia, hypermedia and virtual reality fitted in with the constructivist approach. Computer software that was strictly drill and practice did not fit in with an active discovery environment. Drill and practice did not encourage creativity or discovery. Lecturers did not use the WWW to impart knowledge alone, and students not only used the Web just to learn, but they also used it to communicate their understanding of the subject to those around them.

The administrators in Polytechnics must then model effective strategies in moving lecturers, and otherwise, skillfully provide whatever organizational, technological, human and training guidance that may be indicated to support the efforts of lecturers to construct meaning from their classroom and life experiences, and prepared them for conceptual change.

CONCLUSION

The findings of this study have revealed some of the pertinent issues in the adoption of the WWW and its relationship with the pedagogical approach namely the constructivist

approach in technology education. The conclusions that can be drawn from this study include:

1. Lecturers in Polytechnics reported a high percentage of 73.5% of accessibility to the WWW, mostly through their own initiatives at home or other establishments. Access to online facilities through their workplace was limited and only about 40% of them were able to do so.

2. Subsequently, analysis of the adoption model with respect to the constructivist approach also yielded significant relationship between them. The single linear regression model of the constructivist approach on the adoption model yielded a predictive value of 35% of the explained variance of the dependent variable. This was a considerably high predictive value for a single independent variable and therefore significant in the findings of this study.

7. Merging the two relationships, a simple model can be formed to portray the relationship among all the variables. The path model reinforced the theoretical framework of this study whereby the constructivist approach was supported by the adoption of the WWW.

8. Overall, the predictive nature of the regression models and the subsequent development of a simple model concurred with the interpretation of the relationship among the independent variables with the dependent variable. However, it cannot conclusively establish the causal links among them as no attempts on the experimental nature of this study was conducted.

The Constructivist view of human learning is an epistemological view of knowledge acquisition emphasizing knowledge construction rather than knowledge transmission and the recording of information conveyed by others. The role of the learner is conceived as one of building and transforming knowledge. Therefore, the WWW offers an unprecedented tool of information where both lecturers and students are capable of achieving the academic prowess and success in tackling difficult tasks especially in the field of engineering.

Recommendations

In carrying out this study, the researcher is mindful of the need to assist lecturers who are interested in taking their first steps towards developing constructivist pedagogies to develop teaching strategies that aim to account for students' prior knowledge and preconceptions. In doing so, lecturers may be making use of students' experiences as a meaningful context for the development of students' technical and vocational knowledge. Lecturers may also broaden their pedagogical focus beyond their students' abilities to recall accurately previously learned formulae or knowledge, and provide students the opportunities to develop as autonomous learners. Therefore, the following recommendations were made in light of the findings and implications of the study.

Recommendations for Practice

1. Theory and practical knowledge about how to use the WWW must be made available to lecturers as this knowledge lagged behind the technology itself. This is to be expected. Cuban (1986) surveyed the history of technologies used in education and found a

pattern that included initial stages of excitement and hype, followed by predictable backlashes and retrenchment. Initial uses of a new technology tend to mirror existing educational forms and practices--e.g. traditional classrooms, lectures, and control structures. Eventually, we expect to see greater departure from traditional educational forms, with the Internet and the WWW enabling new paradigms and approaches to learning.

2. Virtual environments could significantly augment local learning environments. But any attempt to view the two as separate, disconnected entities leaves the virtual environment unreachable and the local environment out of touch. Once local learning communities become thoroughly attached to the net, we will begin to see the network inheriting some of the human affordances of continuity, stability, scaffolding, task management, and accommodation of personal style. Therefore, attempts must be made to incorporate the WWW only as a supplementary effort in teaching tasks and not as a replacement for the classroom lectures.

3. These cultural aspects of the WWW use provided rich opportunities for further research, theory development, and guidance for practice. Providing clear guidance for practitioners is a challenge as educators try to bridge the gap between local and virtual learning environments.

4. Provide experiences which guaranteed first-time success by emulating others who had successfully incorporated the WWW into their classroom and remove potential barriers such as not requiring users to install and configure their own software.

5. Provide ample scaffolding from initial direct hands-on to on-line job aids and help facilities, to on-going human (peer) support through proper training.

6. Integrate the WWW resources by providing authentic tasks that provide students legitimate reasons to use the technology. Integrate the WWW resources into traditional classrooms, but also cultivate informal, student-directed uses. The WWW adoption will be most successful in organisations that encourage independent and collaborative inquiry, student-directed learning, and professional responsibility.

7. Encourage adoption of the WWW cultural practices through a variety of incentives, policies, and practices, but keep to a minimum explicit mandates and requirements. Seek to create an atmosphere of expected and natural participation without the feeling of coercion.

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