Does Technology Hinder or Enhance Learning and Teaching?

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Abstract

In higher education, many lecturers are facing the challenges of reaching excellence in both research and teaching. While some of them might admit that if technology would be most useful if it could maximize their time for research and minimize their time for teaching, many lecturers are concerned with the quality of the outcome of learning and teaching when technology is applied. As a professional practitioner in the field of instructional technology in higher education, their concerns also become mine.

This paper shows that the yardsticks for evaluating the effectiveness of technology in learning and teaching could be different and individualistic depending on we interpret the purpose of technology and what are our perspectives on learning and teaching. Subsequently, different learning perspectives could affect how technology could be applied and therefore be responsible for the outcome of the application. However, technology is a double-edge sword; when technology is misused or abused, opportunities in technology could turn into dilemmas. This paper includes many examples of such opportunities and dilemmas in the areas of learning environment, content development, information access, task automation, and communication. Trends and commonalities are found in these opportunities and dilemmas to suggest that we are going through some paradigm shifts of user readiness in response to changing technology and evolving perspectives on learning and teaching.

In order to integrate theory and practice for the readers, this paper also includes some practical guidelines and checklists on how to bring about more opportunities with technology in learning and teaching.

Keywords

[instructional technology, Internet, e-learning environment, re-purposing content, information access, task automation, e-communication, yardsticks for learning and teaching effectiveness, opportunities and dilemmas with technology in learning and teaching]

Introduction

In today's higher education context where there are increased demands on lecturers for quality and accountability in both their research and their teaching, Rosenberg's sentiment is shared by many of the lecturers at HKUST.

> "*The question is no longer whether organizations will implement online learning, but whether they will do it well.*" *(Rosenberg. 2001. Page xviii,)*

They feel that using technology in learning and teaching is not predominantly a debatable issue of "should we do it", but rather an issue on "How well are we doing? How effective are the results?" In other words, they need to identify in advance what are the possible outcomes of technology that may hinder or enhance learning and teaching in order to justify their efforts. As a practitioner of instructional design and instructional technology, supporting lecturers' on-line instructional projects, their concerns become my mine.

This paper aims to explore and discuss the following areas:

- Ways to set premises to evaluate effectiveness of technology in learning and teaching
- Opportunities and dilemmas as a result of using technology in learning and teaching
- Trends and commonalities that might affect the above results

This paper also suggests some guidelines on how to maximize the opportunities and minimize the dilemmas in practice.

My background

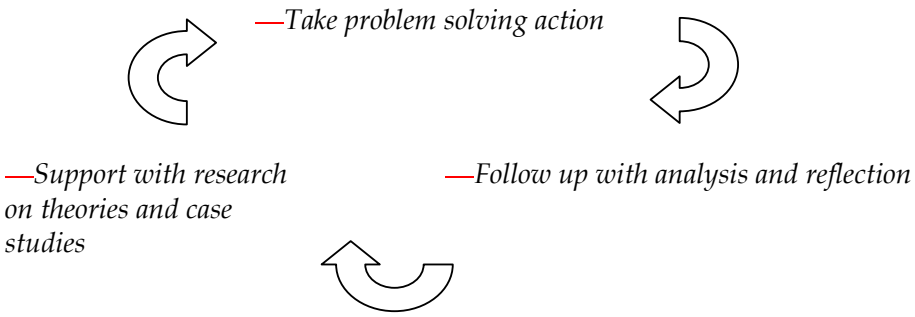
I am the team leader of the Instructional Development Unit at CELT (Center for Enhanced Learning & Teaching) at HKUST. One of our unit's missions is to assist lecturers and teaching support staff on how to effectively use instructional technology in their teaching as well as course development. The expertise areas of my team members include: instructional development facilitation, instructional design, usability, multimedia design, web programming, project management and production. Most of our current projects are on developing online courses in various models that either act as supplements to the face-to-face classroom teaching in different degrees or are totally online. My professional practice enables me to be in touch with many lecturers and learners in their online course development projects, subsequently, I was able to gather a lot of first-hand feedback (IDEAS-OLT. 2001.)

My praxis

The goal of an instructional designer is to integrate theory and practice in the process of learning and teaching enhancement (Gagne. et al., 1992; Seels and Richey, 1994.) It is no exception for me. I adopt this approach (Figure I) faithfully in the following spiral process: first to react to solving problems with actions that come from prior experiences; second to analyze and reflect on the results of the action; third to research for supports or answers for hypotheses or questions that might have been raised in the previous step; and last is to confront with more problem solving situations to apply my cycle of

approach again. This paper is a result of this approach that integrated practice with theory.

Figure I My praxis



Setting Premises

In order to evaluate if learning and teaching were enhanced or hindered as a result of using technology, one would need to identify what is or are the yardsticks for evaluating such a process. To achieve this goal, this paper referred to some mainstream interpretations on the purpose of technology as well as perspectives on how we learn most effectively.

Interpretations on technology

The implications of technology could cover areas such as methods, people, budget resources, facilities, and infrastructure according to different views.

To laymen, information technology and instructional technology are similar in a sense that technology represents mainly hardware and software that are pre-packaged for specific purposes. In order to implement a certain task, you will have to use a specific tool, in other words, user and task are driven by the tools.

> *"Technology is the application of scientific knowledge to practical tasks by examinations that involve people and machines. " (Naughton. 1994. Page 8)*

However, in the context of teaching technology, Naughton implied that technology does not run by itself, but rather involves and depend on how users apply it. Technology could be evaluated subsequently on its applicability and practicability in relationship to user needs.

> *"Instructional Technology (IT) is the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning." (Seels and Richey. 1994 Page 9.)*

From the IT practitioners' perspective, even though the outcome of IT is single minded- enhancement of learning and teaching, the application areas are more comprehensive. Technology can be evaluated specifically in the following domains:

- Design: instructional design, strategies, and learner characteristics

- Development: multi-media, computer-based, and integrated technologies
- Utilization: media utilization, awareness creation, implementation and institutionalisation, and policies and regulations
- Management: project, resource, delivery system, information management
- Evaluation: problem analysis, criterion-referenced measurement, formative and summative evaluation

Interpretations on learning and teaching

We all have our own interpretations on how we learn or teach. These interpretations are influenced by our unique epistemological beliefs. As individuals, lecturers or learners, we bring with us different epistemological approaches that stem from our past unique learning experiences and educational value systems (Laurillard, 1993; Negroponte, 1995; Rossette, 1987.) Therefore, we could have different yardsticks, or perspectives, on what is considered to be effective learning and teaching.

The following sections are some perspectives on how we learn. In order to put these perspectives in context, I have also included some examples of how technology could be applied to achieve these perspectives.

The behavioral perspectives

According to the behavioral perspectives, learning is not self-initiated but rather is a reactive behavior. Learners learn only by responding to external stimuli and corrective feedback (Skinner, 1968; Piaget, 1950.) The responsibility of teaching and achieving correct learning outcomes would mostly belong to the teachers or program designers.

Typical examples of technology could be applied to achieve these perspectives:

- Programmed sequenced incremental learning procedure
- Built-in tutor or agent in the program to guide each step
- Automatic positive reinforcements for correct answers
- Repeated drills to overcome errors until corrected

The cognitive perspectives

According to the cognitive perspectives, learning is natural and hierarchical, and learners come with certain background of experience and value system (Ausubel, 2000; Gagne, 1985; Kemp, 1997.) As a result, knowledge and skills could be stored and transferred from the short-term memory of surface learning to the long-term memory of deep learning which could be retrieved later for application purpose (Ausubel, 2000.) The responsibility of learning is mainly on the students and teaching activities should be pre-designed according to the different needs of students.

Typical examples of technology could be applied to achieve these perspectives:

- Hypertext base hierarchical learning framework
- Interactive learning activities that would address and guide the different hierarchical learning events
- Multimedia simulation of knowledge application
- Interactive self assessment with customized constructive feedback

The constructivist perspectives

According to the constructivist perspectives, learning is also natural and self-initiated. Learning takes place as transforming new information as building blocks to become parts of their existing schema when learners identify the relevance of the new information. Learning is most meaningful when they learn in a social context and if the outcomes would help them to solve immediate work or social challenges (Piaget, 1950; Ausubel, 2000; Bruner, 1971; McBeath, 1992.) The responsibilities of learning and teaching could be reciprocal between learners and teachers.

Examples of technology being used to implement these perspectives are as follows:

- Flexible interactive learning framework to hold independent learning modules
- Virtual collaborative projects
- Multi-media case studies with multi perspectives and real world problems
- Online video broadcast or conferences for asynchronous and/or synchronous discussions or Q&A periods

Opportunities and dilemmas of technology in learning and teaching

As illustrated above, different learning perspectives or theories could shape how technology could be applied. Technology could be used as a tool to implement a goal rather being the goal itself. If one would align one's perspective of learning with one's teaching methods and learning outcomes, (Mager, 1975) then one would have a good chance of using technology effectively to bring about opportunities. The answer to my research question could be very simple. However, from my experience, users of technology do not always consciously have a particular learning or teaching perspective in mind and subsequently their learning objectives for the course could be vague. In addition, opportunities in technology could be missed, misused, or abused in practice, despite of which perspective of learning and teaching one might have and consequently opportunities could turn into dilemmas.

The following sections list some typical examples of both opportunities and dilemmas in the areas of learning environment, content development, information access, task automation, and communication.

Learning Environment

When the Internet paves way for atoms that are transformed to bits, access to information or products are no longer constrained by location, time, or access mode (Negroponte, 1995). Freedom of choice is here. However, Allison Rossette, a veteran instructional technologist, would find her learning experience via the Internet as

> *"The beauty of 'anywhere, anytime, whenever you want, ' too readily turns into 'not now, maybe later, and often not at all." (Rossett. 2001.)*

Opportunity	Dilemma
• Learners have the freedom of choice to decide their own time, place, pace, or path to study.	• Learners are not able to fully take advantage of the opportunities. • The educational experience of most Hong Kong students are "spoon-fed", therefore, they are reactive rather than proactive to learn. • Learners who are used to a teacher center environment would be weak in self directing their study or formulating their own study strategy. • Learners visit the on-line materials or activities mostly only before examinations, therefore, they would find the learning experience overwhelming, unclear, and hard to digest.
• Learning materials could be designed with various entry and exit points that allow the learners to formulate their own learning strategy.	
• Learners can use the on-line materials as preview or/and review depending on their background and knowledge levels.	
• Learners would enjoy the freedom to study at their home and avoid early classes or commuting in heavy traffic.	• Some learners, mostly undergraduates, actually miss the physical congregation at a centralized place to learn. This appears to be a deep rooted institutionalised concept that exist in our learners, not to mention their social needs to elicit and validate learning experiences with peers.
• Learning materials that are enhanced with various media such as sound, narration, video, animation, graphics, etc. provide learners choices to enhance their different intelligence or learning styles.	• When students are not clear how to use the media to their advantage, they would end up having information overload and printing everything they see or hear.

Content development

For administrators, content providers, or developers "write once, reap many" has been raved as the attribute of developing or re-purposing contents digitally. Contents that were just text and graphic based now could be multi-media in one single screen. However many learners are still complaining about WYSINWYG (what-you-see-is-NOT-what-you-get) in their online contents.

Opportunity	Dilemmas
• Technology is becoming more open and versatile to overcome barriers of different computing platforms.	• One of the top complaints for web masters is that users are not able to see and hear data that require special software or plug-ins. • Compatibility among different versions of web browsers or operating

	systems, performance and availability of broadband delivery, etc. are still unstable issues for developers and users.
• When data are digital, contents could be replicated easily.	• Many people equate replication with maintenance. • Digital data that are built with rigid technology cannot be easily modified.
Re-purposing a digital course could offer the following flexibilities: • Course enrolment is no longer bound by the physical limitations of lecture theatres	• hen the target group of a specific course is changed and not the contents then the learning effectiveness would be lowered. The learning objectives and outcomes would be unlikely to align with the new user needs.
• Course could benefit more off-campus students from different geographies	
• Seemingly "one size fits all" course content has significant cost saving advantages for increasing enrolment base quickly.	• One size does not usually fit all. • If learning outcome is the priority then the process of "resizing" contents to "fit" learning could be costly.
• Lecturers who no longer have to meet their students regularly in the classroom could spend more time in their research.	• Lecturers, now become content providers, might find developing an on-line course that engages students would require more work than developing a face-to-face classroom course. • Lecturers have to get used the different roles such as developer in a team, e-tutor, e-facilitator, etc.
• Monitoring on-line students does not require the same rank of teaching staff as lecturers, therefore, could be more cost effective.	• Some lecturers might start to question if their on-line development efforts are actually helping the university to decrease expensive high calibre staff in the long run. • Lecturers do not realize their development efforts are on-going in order to adjust to the changing needs of students. • On-line monitoring should be on-line exchange therefore the quality of the feedback from the teaching staff is very important.

Information Access

The ease and speed of obtaining information on the Internet definitely helps users to empower themselves. However, the same benefits might delude users to overlook issues such as data validity, intellectual property right, efficiency of web cruising, etc.

Opportunity	Dilemma
• The Internet protocols allow individual hubs of computerized information to be connected and exchange data.	• Exchanging information on the Internet could be unsafe due to reasons such as possible spread of computer virus, unclear copyright, unhealthy contents, etc.
• The hypertext system and hyperlinks facilitate users to explore information easily.	• Hyperlinks in the course contents that are designed with unclear objectives and destinations would mislead students into the "never, never land" of cyberspace. • Students do have a choice to stay in the "never, never land".
• Duplicating data such as printing or digitally copying data on the Internet could be reduced to just a couple of mouse clicks.	• Information on the Internet is for the public to view not necessarily for the public to own and re-purpose. • The ease of copying on the Internet deluded users on the uncompromising copyright laws.
• Number of sites and topics of interest on the Internet are growing in a phenomenal rate. • Students are able to find useful information for their fields easily.	• Many learners are not aware that data is not necessarily information, and information is not necessarily knowledge. • The speed and ease of information access on the Internet could lead users to become less discriminatory with the quality and validity of their accessed data.

Task automation

Task automation brings self-reliance to lecturers and learners alike, however, if we are not careful, we could become slaves of the tools that originally were meant to empower us.

> *"Being proficient in the use of a word processor does not guarantee that you'll write the next best-seller." (Rosenberg. 2001. Page xvii.)*

Opportunity	Dilemma
• Computerized automation allows users not have to depend on a chain of division of labors by different people. • Fewer mistakes might be made as a result of less division of labors.	• This is only true if the users want to be in control and welcome extra work, otherwise, they might feel they are trapped in chain of unfamiliar tasks, thus more likely to make mistakes.
• Users are in total control of each task procedure therefore they are in control	• Users are easily spoiled by the deceiving speed and ease of automation

of time for delivery.	and they would procrastinate on executing the tasks • Making changes digitally is too easy so users could become indecisive in making the final version.
• Users could become professionals in certain task quickly with the help of advanced software. • Users are able to visualize their ideas on the computer more quickly.	• Sometimes, if users are not aware of their limited skills with the computer, their ideas could have been visualized differently if they had relied on professional help. • Novice users are easily deceived by professional grade software that are meant to empower professionals in the field.

Communication

When public information is exchanged on the Internet and so is our private communication. Communication on the Internet, or e-communication, enables learners to express themselves synchronously or asynchronously with their team mates or tutors privately or publicly.

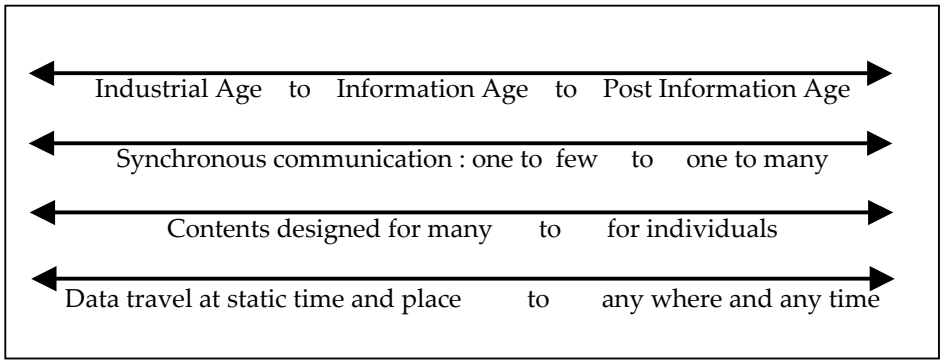
Opportunity	Dilemma
• Learners are able to compose their messages at their own pace and communicate to their audience selectively without pressures from their peers.	• Surprisingly, learners are not proactive in using e-communication. It appears that reticent students in class could also be reticent students on-line. If these learners are subject to peer pressure, then communicating on or off line does not offer significant incentives.
• Learners are able to exchange ideas more personably and directly.	• The speed and ease of sending messages in discussion forums could also invite messages that are fragmented, irrelevant or irresponsible.
• Learners can communicate frequently and directly with their tutors.	• Some learners would become very dependent on their tutors through and would expect response quickly regardless of the time.
• Lecturers could participate in the communication as an equal partner or as a tutor, providing timely input to individuals or groups.	• Lecturers who are using their mailbox to communicate would find their incoming mail quota filled quickly. • Learners might feel they are being "watched" in their discussions. • Monitoring and sorting large classes e-communicating could be a very time

	consuming and difficult job.

Trends and commonalities

In order to be able to minimize the dilemmas and maximize the opportunities as listed above, the next step in my praxis was to observe and analyze these examples for underlying factors or commonalities. The following paragraphs are some of the trends that appear to be paradigm shifts (Figure II) that are affecting the outcomes now and continue to in the near future:

Figure II: Trends that affect the opportunities and dilemmas



Trends in user readiness with technology

Routines of task operation, value system, personal attitudes, etc. cannot be changed easily unless either our work performance or survival is being challenged. Our value system is deep rooted and affected by both of our intrinsic and extrinsic reasons. New technology sometimes could inspire a user need, but actually most of the time is the opposite (Dirkx, 1997; Harris, 1997; Kempske, 1998; Richey, 1987; Rossette, 1987.)

Trends in technology compatibility

The interval between each generation of technology will get shorter and shorter. This trend poses a constant threat to users who are not technically savvy or motivated. (Negroponte, 1995; Rosenberg, 2000.)

Trends in the concepts of curriculum development and assessment

The curriculum design and assessment criteria both become more learner focused and instructional design and usability become increasingly important issues (McBeath, 1992; Kemp. et al., 1997; Seels and Richey, 1994; Rosenberg, 2000.)

Trends in the perspectives of learning, teaching in relationship to needs of the workforce

Today our skill-base society has transformed to a knowledge-base society where human resources are valued for their abilities to solve real world problems. These skills are knowledge driven thus need to be sharpened continually for both graduates and lecturers (Kempske, 1998; Laurillard, 1993; Negroponte, 1995; Rosenberg, 2000.)

Commonalities

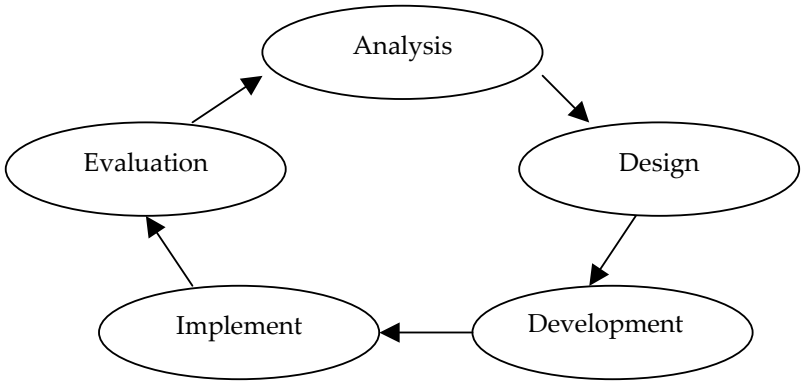
After analysing the different trends, certain common factors emerged as follows:

1. User needs and user readiness would drive the means in technology.
2. Intrinsic factors will first determine the state of user readiness with technology.
3. Extrinsic factors will determine the duration and stability of user readiness with technology.
4. Learners are the center of learning and teaching and their role is becoming increasing autonomous.
5. Learning is no longer limited to subject-base but rather it is becoming more comprehensive, integrated, and life long.

Guidelines for enhancing learning and teaching with technology

In general, being aware of the above trends and commonalities would help you to gain a head start on your learning and teaching projects with technology. In addition, here are some guidelines that will facilitate lecturers to maximize opportunities and minimize dilemmas during the processes of analyse, design, develop, implement and evaluate as in the ADDIE model (Figure III) (Rossett. 1987.)

Figure IIIADDIE model



Get the big picture

Before you start designing the details of the contents, your should first focus on macro issues that will help you decide if the project would be feasible the first place and whether you could handle it by yourself or should you collaborate with other team members. This following list of procedures could help you see the big picture of your project. You might need to consult different experts on some of the topics in the list.

1. Identify who are your stakeholders and their primary needs. These targeted groups might include yourself, your department, your teaching support team, etc.
2. Identify the major goals and requirements for your project such as time, scale, target audience, assessable learning outcomes, etc.
3. Identify quantitative as well as qualitative resources such as manpower, equipment, facilities, funding, and types of expertise support.
4. Identify types of flexible and scalable support infrastructure that could react quickly to factors such as delivery platform upgrade, testing, modification and maintenance issues, etc.

After you have assessed the big picture, you should be able to decide: if it is a do-it-yourself (DIY) project, or a collaboration project; if more financial resources are needed; if your intended deadline were realistic; if you should implement your project in different levels and in different phases of completion.

Adopting a development process

If you decided to move on with your project, no matter which mode you will use or if it is a DIY project, it is still recommended that you adopt a development process or an instructional design model (Figure 3) that will help you through systematically. If you plan to collaborate with other team members, coming to an agreement of a particular type of process would also establish clear communication and expectations for all members at the beginning. A systematic development process usually consists of three major phases and each phase could be broken down into more procedures depending on the time and resources you have (Gagne. 1987.)

1. Plan: the phase is like preparing a blueprint of a dream house.
   This master plan will include major components of the general framework, stakeholders' needs, definitions of the problems to be solved, project goals, sources of support and resources, and an estimated but realistic work schedule with room for handling contingencies.
2. Implementation: the phase is like designing and building the house according to your blueprint.
   This building process will include major tasks such as, designing the detail requirements on how to achieve your goal and objectives, developing learning tasks and sequence, designing assessments for crucial learning points, utilizing

appropriate media to deliver the learning contents, and testing the final implementation repeatedly.

3. Evaluation: the phase is like having the building inspectors and tenants to move in and assess if the construction satisfies them externally as well as internally.

   This evaluation process consists of two stages: the formative and summative evaluations. You should conduct formative evaluations while you are developing and revising the contents. You should conduct summative evaluation when the product is finished and launched in the actual learning environment.

Formulating your personal learning and teaching checklists in advance

Regardless if you plan to develop an on-line course now or later, you will need to accumulate contents, formulate instructional strategies for the contents, formulate the learner profile; and these tasks take time. The following checklists will help you to prepare in advance while you are using the face-to-face teaching mode. The following checklists are on materials preparation, instructional activities design, learner proficiency requirements and assessment alignment.

1. *Materials preparation checklist*

- Expand and enrich your hierarchical course content structure, horizontally as well as vertically.
- Contents and learning tasks should be explicitly clear even without your body language and verbal delivery.
- Data should be original and in digital format as much as possible.
- Accumulate permissions to publish data that are not yours.
- Utilize various types of media in your contents in order to collect a database of multi-media elements for your contents.
- Always record the sources or credits of your reference information such that more advanced or curious learners could be satisfied. This is also a good practice to avoid any unclear copyright issues.

2. *Instructional activities design checklist*

- Design two-way activities that will provoke inquiries and provide direct feedback such as pre-test, post-test, random self assessed quizzes, etc. through out the course.
- Gather examples, analogies, or stories for elaborating abstract or foreign concepts to add relevance.
- Design incidental learning opportunities such as “by the way”, “ did you know that”, or “Guess what” stories or tasks to increase deep learning.
- Propose real world “what if?” questions that would foster problem-solving skills in assignment or group discussion.
- Mix different instructional activities in the same session such as opinion polling, short lecture, task-oriented discussion, short Q&A etc. to engage student learning.

3. *Learner proficiency requirements checklist*

- Identify the basic learning skills for this course.
- Identify the pre-requisites for learners in this course.
- Identify or project the study habits of your learners.
- Formulate a profile of your anticipated learners if possible.

4. *Assessment alignment checklist*

- Identify the weights and types of learning domains for the assessable activities.
- Match your assessment types with the domains of learning.
- Mix different kinds of assessment in your course such that learners could be assessed more comprehensively.
- Ensure your assessment criteria will align with your learning objectives and content design.

Summary

My journey to find out if technology hinders or enhances learning and teaching was both simple and complex. On one hand, when setting premises for different interpretations on technology, learning, and teaching, I found we all could have different yardsticks for evaluating learning and teaching and these yardsticks could shape how technology could be applied and therefore they should be responsible for the opportunities in the outcomes. On the other hand, from the examples of opportunities and dilemmas in my practice, I recognized that opportunities could turn into dilemmas if users are not aware of the double-edge sword of technology in learning and teaching. This paradoxical phenomenon of technology in learning and teaching seems to be related to common trends of users readiness versus changing technology that are affecting all of us. However, if one could grasp the commonalities in these trends and apply them in practice, one could better predict the outcome of using technology.

Professor Greg Felker, a faculty member of the School of Humanities and Social Science at HKUST, in a round table experience sharing session with other colleagues on the topic of using technology in learning and teaching commented,

> *"If technology is the answer, then what is the question? … One has to find out why can't we do without technology before we could make technology add values in our teaching. … Technology is neutral."(IDEAS-OLT.2001.)*

I fully concur with Professor Felker. In applying technology in learning and teaching, the "how to do it" is just as important as the "why do it". However, without the "why", it would leave no purpose for the "how", thus becomes difficult to evaluate if the results hindered or enhanced learning and teaching.

References

Ausubel, D. P. 2000. *The acquisition and retention of knowledge*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Bruner, J. S. 1971. *The relevance of education*. New York, NY: Norton.

Dirkx, J.M. 1997. The illiteracy of literalism: Adult learning in the age of information. In S.J. Levine, (Ed), Proceedings of the Annual Midwest Research-to-Practice Conference in Adult, Continuing Community Education, (pp. 31-36). East Lansing, MI.

Gagne, R. 1987. *Instructional technology: foundations*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Gagne, R., Briggs, L. J., & Wager, W. W. 1992. *Principles of instructional design*. Fort worth, Dallas: Harcourt Brace Jovanovich College Publishers.

Gagne, R.M. 1985. *The conditions of learning* (4th ed.). New York, NY: Holt, Rinehart and Winston.

Harris, R.W. 1997.Teaching, learning and information technology: Attitudes towards computers among Hong Kong's faculty. Journal of computing in Higher Education 9 (2) 89-114.

IDEAS-OLT. 2001. http://www.ust.hk/celt/ideas/olt/experiencesharing.htm. (Retrieved in December, 2001.)

Kemp, J; Morrison, G.R.; and Ross, S.M. (1997). *Designing Effective Instruction*. Columbus, OH: Merrill Publishing Co.

Kempske, F. 1998. *HR 2008: A forecast based on our exclusive study*. Workforce 77 (1). p80.

Laurillard, D. 1993. *Rethinking university teaching*. New York, NY: Routledge.

Mager, R. F. 1975. *Preparing objectives for instruction* (2nd Ed). Belmont, CA: Fearon.

McBeath, R.J. (Ed.) 1992. *Instructing and evaluating in higher education.* Englewoods, NJ: Educational Technology Publications

McBeath, R.J. & J. Kemp. 1992. *The Impact of paradigm shifts on education*. San Jose, CA: SJSU

Naughton, J. 1994. *What is 'technology*? In Banks.J. (Ed). *Teaching Technology*. New York, NY: Routledge.

Negroponte, N.1995. *Being digital*. New York, NY: Knopf.

Piaget, J. 1950. *The psychology of intelligence*. New York: Harcourt, Brace & Jovanovich.

Richey, R. 1992. Designing instruction for the adult learner. London: Kogan Page Limited.

Rosenberg, M.J. 2001. E-Learning. Strategies for delivering knowledge in the digital age. New York, NY:McGraw-Hill.

Rossett, A. 1987. Training needs assessment. Englewood Cliffs, NJ: Educational Technology Publications.

Rossett, A. 2001. *Confession of an e-dropout http://edweb.sdsu.edu/EdWeb_Folder/People/ARossett/viewpoint.htm. (Retrieved in December, 2001.)*

Seels, B., Richey, R.C. 1994. *Instructional technology: The definition and domains of the field.* Washington, D.C.: Association for Educational Communications and Technology.

Skinner, B. F. 1968. *The technology of teaching*. New York, NY: Appleton