



THE NATIONAL
UNIVERSITY
of SINGAPORE

CDTL *Link*

Centre for Development of Teaching and Learning

January 1997 Vol 1 No 1

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in the 21st Century

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Implications of Changes in the 21st Century for Post-secondary Education*

Professor C.C. Hang, Deputy Vice-Chancellor

Singapore has done well through the years by adopting foreign technology and providing political stability and a sound economy within which investors can operate successfully. Our focus on quality education has produced a workforce which is able to learn and apply foreign expertise quickly and effectively. This formula for success, however, will not be sufficient in the next phase of growth.

In less than four years' time, Singapore will enter the 21st Century as a developed economy and will compete with other larger developed economies in the first league. Moreover, it has been widely recognised that economic competition fuelled by technological innovations will be much more intense in the 21st Century. We will thus need to ensure that we have world-class capabilities and quality human resources to survive and advance as a developed economy. Singapore's competitiveness will depend more and more on its ability to innovate (i.e., to develop higher value-added processes, better quality products and services) continuously, in order to keep ahead of strong competitors.

What are the major implications of the above changes in the 21st Century for post-secondary education in Singapore? This is a topic of great interest today as you are working upstream of the whole education process. You will naturally want to know the possible future scenarios so that you can examine the necessary changes in schools in order to better prepare the students for their next stage of education.

I shall focus on the implications for university education but these should have general applicability. After a quick survey of the changes in skills and competencies that graduates should have in the 21st Century, I shall discuss what corresponding changes should be made to the teaching and assessment methods at the university in order to ensure that the requisite learning objectives are achieved. This will include the appropriate and innovative use of information technology to enhance learning. Next, I shall discuss the often neglected but essential role of the non-academic aspects of university education, in particular their contribution to developing the students' emotional intelligence. I shall end by stating my view on the need for formal training of all academic staff and briefly relating what I have discussed to the development of entrepreneurial qualities.

1. CHANGING SKILLS AND COMPETENCIES

When knowledge and technology can be easily imported, the primary concerns of the workforce are rapid implementation and adaptation. Reduction to practice, technology transfer and problem-solving involve know-what and know-how skills which for the most part use logical reasoning and analytical thinking.

Creative problem solving. There is little need for originality, creativity or innovative thinking except for a small number of senior managers

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* Presented at "Planning for the 21st Century", a seminar for principals, vice-principals & key personnel of schools, 3 September 1996.

and leaders who are in charge of overall policy, planning and strategy selection. This scenario will change rapidly. To prosper in the 21st Century as a small country and compete with the top tier of developed countries, Singapore needs to have exceptional performance.

As reminded recently by our Deputy Prime Minister Lee Hsien Loong (when he gave the opening speech on 28 May '96 to launch the NUS's Annual Literacy Encounter Programme), creativity can no longer be confined to a small elite group of Singaporeans. The whole workforce needs creative problem-solving skills and they cannot just follow their leaders without thinking and understanding. He stressed that we need a sound educational system which stretches our students' creative potential. For university students, it is therefore essential that they be equipped with higher-order thinking abilities, which include analytical, creative and systems thinking, in order to function more effectively in the workplace of the 21st Century.

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Teamworking and networking. To achieve exceptional performance, Singapore also needs to mobilise and harness the strength of teamwork and network. Individuals must be equipped with interpersonal and teamworking skills. Teamworking is especially important for high-tech economic competition as success there requires specialists from the different disciplines of science, engineering, marketing, sales, finance and others to work as a cohesive team. A modern concurrent engineering approach to reduce time-to-market and thus gain competitive advantage requires even more intimate working relationships and trust among many people.

Even in non-high-tech organisations of the future, the use of information technology will be so pervasive that organisational structure will be flattened and workers will be empowered to form ad hoc teams to solve problems with little supervision. Networking provides extra resources for mutual collaboration within the organisation and the global village. If Singapore can truly take advantage of global resources—capital, materials and knowledge—the natural limitations of a small nation can be minimised.

Finally, team and network effectiveness would be enhanced if the members possess shared values and a strong sense

of social responsibility in addition to social skills. University education should continue to build on the foundation which has been laid by schools and contribute towards all these aspects of non-academic development.

Information technology and lifelong learning. The advances in information technology (IT) have accelerated the arrival of the information age in which the rate of knowledge generation is exponential and the life cycle of information will continually shrink. With easy access to abundant information, a proactive mindset and competencies to seek, process and apply relevant information will take precedence over the actual knowledge content.

Knowledge workers (especially scientists and engineers) of the 21st Century are also expected to retool themselves every three to five years. It is thus essential that they receive an education which provides a broad, multidisciplinary foundation for lifelong learning. At the extreme, knowledge workers will be using IT tools to acquire just-in-time specific knowledge, and they will need to acquire the discipline to set aside time for learning every day.

II. IMPLICATIONS FOR TEACHING AND ASSESSMENT

While changes in the 21st Century will be rapid and drastic, the time taken to equip our graduates with the desired skills and competencies cannot be shortened significantly. It therefore behoves educators to anticipate these changes as early as possible and proactively change the present methods of university teaching and assessment to ensure that the requisite learning objectives are achieved.

Teaching learning skills. The acquisition of knowledge is no longer the most important objective of university education. The acquisition of process skills, i.e. learning how to learn, is equally important, if not more important, than the acquisition of knowledge itself. Process skills refer to the abilities to source, analyse, screen, prioritize and apply a mass of information to solve the problem at hand. Such skills are especially important in the new era where the growth of knowledge is explosive and lifelong independent learning is essential. The academic staff should realise that the learning of process skills is more time-consuming, and

hence they need to make suitable adjustments to the subject syllabus in order that the students are not overloaded.

Another more important consequence is that the teaching method should shift in emphasis from passive lecturing to mentoring and small group tutorials. Academic staff mentors who are active researchers would be ideal persons to inspire the students to develop strong interests in learning and guide them in exploring alternative ways of approaching a new topic or resolving an open-ended problem. Small group tutorials would also enable students to participate more actively in group discussions and further develop their listening and speaking skills.

With the help of multimedia and advanced communication technology, it may also be feasible to supplement face-to-face tutorials with interactive tutorials in cyberspace. Consultation with academic staff virtually any time and anywhere, and cooperative learning among students, may be facilitated thanks to the advances in IT tools. Academic staff can decide on the appropriate balance between more costly face-to-face sessions and less personal IT tools depending on the specific overall learning experience of the individual student and whether the subject is a core requirement or an option. (Note that I have used the term "academic staff" instead of "lecturers" as the latter may become a misleading term in the 21st Century!)

Teaching creative thinking. Our educators need to take up the challenge of developing the creative thinking abilities of students. The present method of teaching focuses on developing the analytical thinking abilities. Students are educated to think in a convergent manner and to arrive at unique answers to closed-ended simplified problems, particularly in the science and engineering disciplines. Real-world problems that need creative thinking are usually complex, not well understood, and tend to have more than one appropriate answer.

Creative thinking skills can be developed by exposing students to the process of creative thinking by conducting workshops designed for them to practise idea generation, synthetic thought and other forms of creative thinking, and by integrating the teaching of creative thinking skills into the subject areas. It is, however, important to

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Total Quality Management



CDTL organised a seminar/dialogue session in July to address the emergence of TQM in the world of academia. The guest speaker was **Mr Alan Maley**. Prior to joining NUS as a Senior Fellow, he was Director General of the Bell Educational Trust in Cambridge, and in that capacity, gained considerable experience with quality management. Highlights from his talk are reported below.

"We judge ourselves mostly by our intentions, but Others judge us mostly by our actions."

(Harvey & Lucas, 1993)

A Brief History of TQM

Total Quality Management, or TQM for short, has become the catch phrase of the 90's. It began in the manufacturing sector with the purpose of improving customer satisfaction and keeping production costs continually low. It is a management system that focuses on people and has made inroads into the service sector and more recently, into the educational field. TQM has been adopted by numerous bodies for various reasons, but all believe it will provide an opportunity for growth and give them the competitive edge.

Implementation Implications

Implementing new ideas or management styles is never easy. The introduction and adoption of TQM in the workplace inevitably raise some concerns.

- Do people believe in the possibility of continuous improvement at both personal and institutional levels?
- Do people understand the aims and objectives of TQM and will there be a commitment at all levels to make it work?
- How will it affect the machinations of the work environment and people's attitudes and perceptions?
- Attention must be paid to all aspects of TQM; this takes time and effort.
- Effective communication is imperative at all levels; the right people must get the right information at the right time.
- Prevention, not correction, will become the order of the day; people will have to get it right the first time.
- Documentation is crucial to ensure clarity of standards and as a means of evaluation and appraisal.
- Concentration on customers' needs means a focus on feedback.
- People will require time to adjust to the changes TQM brings.

Implications in Academic Settings

The emergence of TQM in academia has led to a reassessment of existing practices. For example, in its original form, TQM aims to increase customer satisfaction and keep costs low. In the academic setting, TQM places

greater emphasis on quality teaching than on low costs. Other issues include the following.

- *Customer Satisfaction—Students.* Review courses for relevance, content and usefulness. Students' academic needs must be met.
- *Customer Satisfaction—Others.* Employers hiring NUS graduates must be satisfied with them. In addition, the government and parents also expect certain standards to be met.
- *Customer Satisfaction—Staff.* The needs of internal customers (e.g., co-workers and colleagues) should also be considered. In this instance, TQM deals more with interpersonal dynamics like team spirit and synergy.
- *Quality Teaching.* This is difficult to define, measure and quantify. Standards, teaching methods, research output and other academic activities cannot be sufficiently graded to arrive at a working definition of "quality". At best, long-term studies of results and monitoring can help establish some means of measurement.
- *Cost.* Expenditure is another consideration. Current practices should be assessed to increase effectiveness and lower costs.

Implementation Concerns

Some difficulties may arise as TQM exerts a greater degree of influence in academia. For example, in industry, the product is important but education is a process, not a product. Also, start-up and implementation costs will be quite staggering and require plenty of time and effort. The transition period will force people out of their comfort zone, causing resentment and resistance to TQM. The increase in bureaucracy could dampen professional interest as an endless flow of paper work becomes a turn off. Lecturers will have to wrestle with the "customer is always right" maxim, especially when what students want (e.g., more holidays and fewer exams) is not what they need. To gauge quality teaching, the practical but controversial method has to be employed—measure quantity. And finally, changes may only be superficial, not extending beyond hype and jargon. ■



Teaching Critical Thinking

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4 *What is critical thinking?* Most of us would agree that critical thinking is the mental process on the basis of which we make reliable judgements on the credibility of a claim or the desirability of a course of action. Members of a jury use their critical faculty to scrutinize the evidence presented in court to decide whether the accused is guilty or innocent. Members of a board of directors use their critical faculty to decide whether a proposed reform would be beneficial or harmful.

The above characterization of critical thinking contrasts with the narrow view that equates critical thinking with the application of classical deductive and inductive logic, and the use of the checklist of the logical fallacies found in logic textbooks. Pedagogical approaches that incorporate the logic-based view have two serious flaws. First, they give the misleading impression that reasoning is the sole ingredient of critical thinking. Other central ingredients of critical thinking, such as assessing the credibility of the facts presented, looking for additional facts which could be inconsistent with the proposed conclusion, looking for alternative conclusions, choosing between alternative conclusions, and so on, hardly ever figure in traditional treatments.

Second, even within reasoning, the traditional programme ignores the types of formal and informal reasoning that lie outside the domain of classical logic. Traditional logic covers only a small fragment of the reasoning actually used in academic activities and everyday life. For instance, most traditional books on critical thinking hardly mention the central concepts of critical thinking needed for the assessment of conclusions based on experimentation, such as sampling biases and standard deviation, as such topics are found in textbooks on statistics rather than classical logic.

Given the above view, let us ask: *Can critical thinking be taught?* The answer depends on what we mean by "teaching". If "teach x critical thinking" means "make x think critically", the answer is probably no. But if it means "help x acquire the ability to think critically" or "help x improve the ability to think critically", the answer is yes. If teachers can help their students learn to paint, sing, dance or play chess, they can also help students develop or improve the ability to think critically.

How can we teachers help our students develop their critical thinking faculty? A standard response would be: give the students one or two lectures on criti-

cal thinking. However, I doubt very much if we can make any serious difference if a curriculum devotes to critical thinking one or two lectures, or even a whole module, but ignores it in remaining modules. Whether or not such specialized lectures or modules are available, we need to incorporate critical thinking in every module we teach.

Viewed from the broad perspective of the modes of assessing the credibility of claims and the desirability of actions, we may distinguish between global and discipline-bound critical abilities. When I critically read a research paper in my area of specialization and make an assessment of the claims made in the paper, I use my *discipline-bound* critical faculty, which involves making use of the information available in my discipline, as well as the modes of thinking frequently employed in my discipline. In contrast, when I critically read a newspaper article or an article in *Scientific American* on a topic outside my discipline, I use my *global* critical faculty. These two levels of critical thinking clearly interact and reinforce each other.

From this vantage point, each module taught in a university has a role to play in strengthening certain aspects of critical think-

ing. For instance, a module in experimental psychology may tend to focus on the ability to assess experiment design and statistical data, while a module in theoretical chemistry may tend to focus on the ability to assess theoretical interpretations, test predictions, look for alternative interpretations, and so on. Hopefully, the combined effort from a number of disciplines will lead to the enhancement of global critical thinking as well.

A frequently-voiced complaint among university teachers is that students are unwilling, or even unable, to think critically. Assuming that this feeling is not baseless, let us ask: *Why is critical thinking underdeveloped among students?* The answer, I think, can be stated as follows. An essential prerequisite for the development of critical thinking among students is the critical understanding of what they learn in their classes. The traditional framework of education that most of us rely on does not have a provision for critical understanding, and hence does not facilitate critical thinking.

By *critical understanding* I mean the understanding that involves not only familiarity with the concepts and propositions that we call knowledge, and the ability to apply them to new situations, but also an awareness and appreciation of the evidence for what is presented as knowledge. Textbooks and lectures typically present the *conclusions* arrived at by the academic community, but they rarely present the evidence that leads to these conclusions, or the *arguments* that support them. In the absence of evidence and argumentation, students are not in a position to critically evaluate the knowledge presented to them. All they can do is accept on trust what is handed down to them, a situation that is hardly conducive to the practice of critical thinking.

Let me explain. Most educated people in the twentieth century believe that the earth rotates around its axis, and revolves around the sun. However, very few people realize that these are not observable *facts*, but only theoretical *interpretations* supported by considerable evidence. The only way to observe the earth's revolution around the sun is to go outside the solar system, for which space travel has not equipped us with yet. There is no way to observe the earth's rotation, unless we go outside the universe to observe the earth and the stars from an independent reference point. When viewed from the earth, all we can see is a pattern of changes in the location of the heavenly bodies: while the position of the star called Polaris appears fixed, the rest of the stars describe a circular motion around Polaris. This observed fact can in principle be explained by assuming either that the earth rotates around its axis, or that the sky rotates around the earth. Why then do we now accept the former hypothesis rather than the latter one? The answer is that the assumption of the earth's rotation (combined with a few other assumptions) allows us to calculate, in a simpler manner, the observed changes in the locations of stars and other heavenly bodies. Until we can find a better set of assumptions, we must subscribe to the hypothesis of the earth's rotation.

Critical understanding entails raising the question (e.g., What is the evidence that justifies the assumption of the earth's rotation?) and being able to make an assessment of the evidence. For students to become aware of such questions of evidence and to assess the evidence relevant to conclusions, it is important that textbooks and teachers help them become aware of this dimension of human knowledge. By and

large, traditional education does not deal with questions like:

- What is the evidence to assume that human beings evolved from monocellular organisms?
- What is the evidence to assume that oxygen has a valency of two?
- Why should we assume that there are such things as electrons, and that they are negatively charged?
- Why should we assume that there is such a thing as social class?

For instance, chemistry textbooks tell students that a molecule of water consists of two atoms of hydrogen and one atom of oxygen, but they generally do not discuss the facts and arguments that support this conclusion, let alone discuss Dalton's idea that one atom of hydrogen combines with one atom of oxygen. As a result, students get into the habit of uncritically accepting as facts the theoretical assumptions presented to them in their textbooks and lectures. By leaving out critical understanding from the curriculum, the traditional framework of education pre-empts the possibility of critical thinking.

As long as textbooks and lectures fail to deal with evidence, alternative conclusions and argumentation, it would be unrealistic to expect students to develop critical thinking. The first step towards the teaching of critical thinking is therefore bringing into our syllabuses, lectures and examination questions, not only the conclusions accepted in the academic community, but also the evidence and argumentation that demonstrate the credibility or lack of credibility of these conclusions and their alternatives. ■

Quality, Critical Thinking and Assessment: A Note

This article is contributed by **Dr Desmond Allison** from the Department of English Language and Literature in response to a seminar/dialogue session on "Strategies for Teaching Critical Thinking".

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common rhetorical scenario that I think we should review very critically casts assessment as the chief villain of education, restricting teaching and learning activities to the purveying and regurgitation of unquestioned knowledge frameworks that are embodied in textbooks and on lecture notes. Such assessment-driven teaching (presented as bad, but common) is then contrasted with those (desirable, but rare) critical and creative modes of thinking in which knowledge frameworks are questioned and challenged. This sort of rhetoric unfortunately encourages an impoverished analysis of educational practices and condemns most learners and teachers to failure before we have begun.

The notion that *creativity* necessarily requires a refusal of conventions in a search for new forms, as more than one workshop discussant seemed to assert, rather amusingly reflects a particular set of educational and cultural conventions rather than a universal truth. A struggle to reconcile the expression of fresh meanings and insights with existing formal constraints is an alternative, widely attested and potentially relevant depiction of creativity.

When considering *critical thinking*, most workshop discussants focused on critical appraisal of dominant theories and on the search for new and better theories, rather than on raising and investigating questions that arise within theoretical frameworks. This may partly reflect the fact that more

specific questions usually arise in particular subject disciplines: an exception is that questions about frameworks themselves are part of the normal (second) order of the day for the academic study of philosophy. A focus on shifts in knowledge paradigms makes sense in a course on epistemology.

To retain such a focus, however, when reviewing the place of critical and creative thinking throughout academic curricula will prove restrictive and educationally self-defeating. How many (or how few) people discover or create new paradigms; how many even believe that they have done so? How many more people work and think within existing paradigms? If there were no place for critical or creative thinking within existing knowledge frameworks, there would be little hope for most of us or for most education. In such a starkly uncompromising account, even new paradigms would only form additional barriers to others, rather than offering wider opportunities for revitalised thinking.

The point of this note is to suggest that asking questions and seeking alternative explanations are activities to be encouraged at the heart of existing frameworks of knowledge and education, and not only in opposition to them. How far enquiry does or does not take place in recommended texts and on lecture courses is open to investigation and change.

Whether we are concerned with propositional or procedural knowledge, or with combinations of these modes as in data analysis and interpretation, there should be scope for encouraging students to address and ask genuine questions as they work within provisional assumptions at various levels of application. Such questioning points the way beyond simple reproduction of prior "knowledge" to its exploration and testing in contexts of use, and that process can lead at times to more fundamental reappraisals. What kinds of learning activities and assessment procedures do people suggest will best serve such educational ends?



Ethical Principles in University Teaching*

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Preamble

The purpose of this document is to provide a set of basic ethical principles that define the professional responsibilities of university professors in their role as teachers.

Ethical principles are conceptualized here as general guidelines, ideals or expectations that need to be taken into account, along with other relevant conditions and circumstances, in the design and analysis of university teaching.

The intent of this document is not to provide a list of ironclad rules, or a systematic code of conduct, along with prescribed penalties for infractions, that will automatically apply in all situations and govern all eventualities. Similarly, the intent is not to contradict the concept of academic freedom, but rather to describe ways in which academic freedom can be exercised in a responsible manner.

Finally, this document is intended only as a first approximation, or as food for thought, not necessarily as a final product that is ready for adoption in the absence of discussion and consideration of local needs.

Ethical Principles in University Teaching was developed by the Society for Teaching and Learning in Higher Education and is endorsed by the winners of the National 3M Teaching Award whose names appear on the cover page. The document was created by individuals actively involved in university teaching, and will be distributed to university professors across Canada.

The Society for Teaching and Learning in Higher Education (STLHE) believes that implementation of an ethical code similar to that described herein will be advantageous to university teachers (e.g., in removing ambiguity concerning teaching responsibilities) and will contribute significantly to improvement of teaching. For these reasons, STLHE recommends that the document be discussed thoroughly at Canadian universities, with input from professors, students and administrators, and that universities consider adopting or implementing ethical principles of teaching similar to those described in this document.

Principle 1: Content Competence

A university teacher maintains a high level of subject matter knowledge and ensures that course content is current, accurate, representative and appropriate to the position of the course within the student's programme of studies.

Principle 2: Pedagogical Competence

A pedagogically-competent teacher communicates the objectives of the course to students, is aware of alternative instructional methods or strategies, and selects methods of instruction that, according to research evidence (including personal or self-reflective research), are effective in helping students achieve course objectives.

Principle 3: Dealing with Sensitive Topics

Topics that students are likely to find sensitive or discomforting are dealt with in an open, honest and positive way.

Principle 4: Student Development

The overriding responsibility of the teacher is to contribute to the intellectual development of the student, at least in the context of the teacher's own area of expertise, and to avoid actions such as exploitation and discrimination that detract from student development.

Principle 5: Dual Relationships with Students

To avoid conflicts of interest, a teacher does not enter into dual-role relationships with students that are likely to detract from student development or lead to actual or perceived favoritism on the part of the teacher.

Principle 6: Confidentiality

Student grades, attendance records and private communications are treated as confidential materials and are released only with student consent or for legitimate academic purposes or if there are reasonable grounds for believing that releasing such information will be beneficial to the student or will prevent harm to others.

Principle 7: Respect for Colleagues

A university teacher respects the dignity of her or his colleagues and works cooperatively with colleagues in the interest of fostering student development.

Principle 8: Valid Assessment of Students

Given the importance of assessment of student performance in university teaching and in students' lives and careers, instructors are responsible for taking adequate steps to ensure that assessment of students is valid, open, fair and congruent with course objectives.

Principle 9: Respect for Institution

In the interests of student development, a university teacher is aware of and respects the educational goals, policies and standards of the institution in which he or she teaches. ■

* This is an abridged version of a document published by the Society for Teaching and Learning in Higher Education.

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The authors are indebted to the following for ideas that were incorporated into the present document.

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Centre for Development of Teaching and Learning

A Message from the Director, Dr Daphne Pan

At the Vice-Chancellor's direction, the former Centre for Educational Technology was renamed the Centre for Development of Teaching and Learning (CDTL) in February last year. I am pleased to report in this first issue of the Centre's newsletter that the past year has been an interesting and productive time.

The Centre was given an extended brief with the change in name. In addition to providing technical support and facilities, it became the hub for promoting excellence in teaching and learning. Good teaching has always been highly valued and expected at NUS; what is notable is the increased and increasing attention to enhance learning. As the University prepares to move into the next millennium, it reiterates its mission "to excel in teaching and research and contribute to the nation's development". Recognising that a world-class university cannot neglect its primary function of delivering a sound and high value-added education, the recent exercise in strategic planning chaired by Deputy Vice-Chancellor Chang Chieh Hang identified among six major thrusts the enhancement of NUS as a centre for quality education and the spearheading of continuing higher education.

With the guidance of Deputy Vice-Chancellor Chong Chi Tat, to whose office the Centre reports, CDTL aims to contribute to the University's goal of ensuring excellence in teaching and learning while sustaining a vigorous research programme. In its first year, the Centre has put in place a fairly extensive programme to support the NUS academic community. We now provide more frequent

induction programmes so that all new staff receive some guidance at the outset and are encouraged to obtain on-going support from a series of workshops conducted in small groups and designed with a good deal of 'hands-on'. Workshop topics have included the following.

- Instructional design
- Encouraging interactive learning in large group teaching
- Optimising small group teaching
- Oral communication skills
- Developing lecturing skills through micro-teaching
- Assessments and examinations
- Dealing with difficult teaching/learning scenarios
- Effective use of OHP transparencies
- Slide-making
- Video production and editing
- Multimedia software production
- Computer-based printing and imaging
- Introduction to staff self-access facilities



Multi-image slide programming.



Video post-production editing.

To contribute to an environment conducive to reflective teaching practice, CDTL provides various platforms for discussion and experience-sharing. During the past year, monthly seminar and dialogue sessions were mounted on the following topics.

- Producing high value-added students
- TQM: Does quality matter?
- Strategies for teaching critical thinking
- Obtaining and using feedback to improve teaching
- Strategies for graduate research and supervision
- Maximising the use of the computer for teaching and research
- Computer-aided lecturing: Principles and examples
- The Internet and interactive multimedia: Applications in the development of teaching and learning at NUS

In addition, we have setup newsgroups to facilitate electronic exchange of views and ideas. We also continue to disseminate literature on teaching and learning issues.

CDTL is in the process of setting up student/learning support services and facilities. We currently offer an on-line university foundation skills module and hope that with additional manpower, we will be able to provide more structured and personalised support for students, especially those with learning difficulties, as well as training in skills that augment personal development.

The Centre is actively exploring and developing new methodologies such as alternative teaching and learning approaches that promote thinking skills, autonomous and lifelong learning habits and innovative modes of assessment. Working with the Computer Centre, we are spearheading the use of IT as a teaching and learning tool.

As evidenced by the articles contributed to this inaugural issue of *CDTLink*, University staff have strong interest and expertise in educational development. With this in mind, we hope to stimulate interest in, and provide support and funding for, active research in this area. Classroom observations, innovations in teaching methodologies and exploration of new paradigms are all potentially significant bases for valuable research.

Guided by a collaborative rather than prescriptive ideology, we welcome input from all staff. Indeed, in the past year, we have drawn greatly on support and participation from various quarters: the Vice-Chancellor, Deputy Vice-Chancellors, Deans, Heads and fellow teachers. I would like to take this opportunity to thank each and every one of you, and to ask for your continued support, so as to enable CDTL to serve this community of scholars in its pursuit of excellence. ■



In 1992, the National University of Singapore initiated the use of video teleconferencing technology to enhance its teaching, learning and research environment as well as to further its industrial collaboration activities. Video teleconferencing is real-time digital communication utilising multimedia (video, audio, graphics and document transfer, white boarding and text-based chat); it costs about \$400 an hour. With the system, the NUS community is able to access tertiary institutions and other organisations abroad.

The present operating system provides two remote control video cameras, one document camera for transmitting documents (charts, statistical tables, transparencies, etc.), one or two projection screens and basic studio lighting and audio system amplification.

The facilities and network are managed and operated jointly by the Computer Centre and CDTL, which serves as the hub with a Picture Tel Coder-Decoder system installed to provide linkage to the following five sites on campus.

- Faculty of Medicine, Clinical Research Centre Auditorium (100 person capacity)
- Faculty of Science Auditorium, Lecture Theatre 31 (100 person capacity)
- Computer Centre Auditorium (80 person capacity)
- Faculty of Business Administration, Conference Room A (50 person capacity)
- Centre for Development of Teaching and Learning Studio (20 person capacity)

During a video conference transmission, a call is made from or received at the CDTL hub, like one would make a normal telephone call. The analog image and sound from the site is sent to the computer (CODEC) at CDTL and converted into digital information which is then transferred to Singapore Telecom where it is bounced via satellite to the foreign site. There, the service provider sends the information to the other CODEC which reconverts the digital information so that the audience can see and hear the CDTL site with their audiovisual equipment. The process is reversed for two-way interaction.

To date, there have been over 65 major video conferences with top-level academic, research and industrial institutions as well as individuals worldwide. Usage of the system falls under three categories.

Specialist Lectures. Eminent specialists, including those on the Lee Kuan Yew Distinguished Visitors Programme, have given lectures using video conferencing technology to specific groups to enhance research interests and knowledge. NUS specialists have also given such lectures to foreign institutions but there is room to grow.

Course Work. Video teleconferencing can be used periodically for graduate programmes like the Cornell-NUS Executive Programme, the Harvard-NUS Masters in Public Policy Programme and the Stanford-NUS Business Programme. This year, the English Language and Literature Department organised the first series of course lectures via video teleconferencing with the University of Manchester. More projects from other departments are now in the pipeline.

Meetings. On a periodic basis, researchers can use video conferences to collaborate on or monitor the progress of joint projects. There has also been limited use of video conferencing for administrative consultation and planning.

With technological advances and improvements in technical support, video teleconferencing will continue to grow in importance as an tool for education. ■



Video Teleconferencing: The Global Classroom

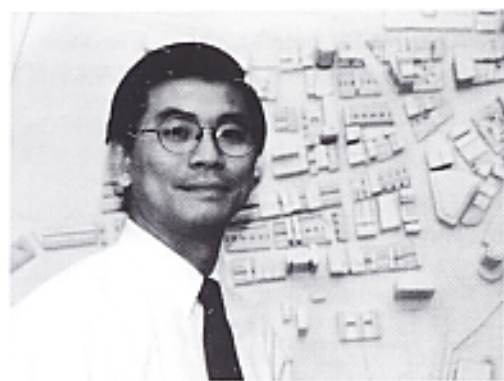
**Mr Joseph Peters,
Assistant Director, CDTL**



If you are interested in video teleconferencing or would like to know more, contact Mr Joseph Peters at 772 2473.

A Faculty-wide Initiative in Using IT for Teaching/Learning: The Experience of Architecture and Buildings in Mounting Lecture On-Line

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In response to the University's call to promote the use of IT to enhance teaching, the Faculty of Architecture and Building has undertaken a comprehensive exercise to place on-line all

lecture course materials from both the School of Architecture and the School of Building and Estate Management.

The phenomenal growth and development of the Internet has opened up new opportunities for information presentation and exchange through links within the vast World-Wide Web network. An increasing number of academic institutions throughout the world have established server nodes with links to web pages created by their own academic staff as well as by other academics around the world to deliver and share teaching materials. Some of these major links (e.g., the World Lecture Hall) are captured in the newly established NUS Computer-Based Education Information Map.

Most of these digital information repositories rely on voluntary contributions from staff members. Our Faculty felt that to realise the maximum impact and benefit for both staff and students, a concerted effort is necessary, with full support and participation by all staff. It was decided that all lecture courses offered in the School of Architecture (for both the BA (AS) and B Arch degrees) and Modular Courses (Levels 1 and 2) offered in the School of Building and Estate Management (for the BSc (Building) and BSc (Estate Management) degrees) would be placed on-line in the first instance. The School of BEM is transitioning to the modular system, and Levels 3 and 4 course materials will be uploaded into the system when they are available.

To facilitate efficient search and information retrieval, a common framework is established. Each School is provided with a homepage indicating the module code,

title, type (e.g., essential, elective or enrichment) and the lecturer's name. The module is linked to the homepage of the appropriate lecture course. These pages contain the following basic information.

1. Course Objectives
2. Lecture Title Listing
3. Method of Teaching (e.g., lecture, tutorials, labs)
4. Assessment (e.g., project work, assignments, examinations)
5. General Reading List

The Lecture Title Listing is in turn linked to sets of pages containing text and graphics relating to each lecture. Academic staff have complete freedom to present their material in whatever format they wish. Initially, most material probably will be "self-contained". However, as staff become familiar with accessing and using the system, they can make links to the extensive resources available globally. We will see a paradigm shift in the way lecture notes are prepared. For example, there might be more dynamic keyword links to encourage students to explore concepts interactively and conduct their own independent research and study rather than being limited by the traditional "static" and "self-contained" lecture handouts. Modes of presentation will also be greatly expanded from conventional text and graphics to multimedia applications to convey information in the most effective manner.

Initially, Lecture On-Line will be accessible by staff and students of the Faculty through NUS IntraNet. Eventually, as the system is thoroughly tested and all staff members become familiar with the procedures for updating and editing their own lecture material, it will be opened to all members of the NUS community for reference.

The staff of the Faculty of Architecture should be commended for their tremendous effort in contributing towards this Lecture On-Line System. ■

realise that the higher order thinking skills to be further developed in university education include both analytical and creative thinking skills and the latter does not displace/replace the former. Indeed, as Dr. Edward De Bono, a world renowned authority on the subject of creativity has estimated, creative thinking may be used only five percent of the time in practice. Creative thinking is especially important in formulating problems and exploring alternative methods. Final decision-making, based on the evaluation of alternatives and the detailing of action plans for implementation, will require analytical thinking, and this will occupy the other 95% of the time.

Incorporation of creative elements in course contents requires academic staff to reformulate the problems so as to give students an opportunity to exercise their creative thinking skills and to encourage the adoption of an "open mind" attitude during the process of learning the knowledge contents. Exercises in problem formulation and visualisation, as well as learning through discovery, are additional methods the academic staff can explore. Fortunately, advances in artificial intelligence and cognitive psychology have also given us many creativity tools which may be used to facilitate and enhance learning.

Alternative assessment methods. Assessment methods will also need to be reviewed with the shift in teaching emphasis and in the incorporation of creativity in education. One major obstacle to the acquisition of process skills is the habit of rote learning which does not promote engagement with and real mastering of what is being learnt. As a result the students tend to lose interest early.

To move students away from rote learning, the use of alternative assessment methods, such as the open-book examination which lends itself to testing the students' process skills in problem-solving, should be increased. Examination questions should also be less predictable to discourage reliance on practising past-years' papers and on recall capabilities. Open-ended problems along with open-book examinations are better suited to assess the students' creative thinking abilities to solve non-structured and non-routine problems. These will supplement con-

ventional methods for testing a student's ability in analysing and solving structured problems. Individual oral presentations and participation in tutorial discussions should be graded and given sufficient weightage to encourage the development of good communication skills. To encourage the development of teamworking skills, bonus marks may be awarded for good teamwork or outstanding team performance.

The increasing use of IT tools for interactive tutorials and independent project work provides another means of assessing students' progress and achievement. In a brainstorming exercise, for instance, the creative thinking skills of a student can be assessed by the number and quality of the alternative ideas proposed. These can be easily tracked using computer software.

Broad-based knowledge. I would like to mention two other important considerations. Owing to the time constraint, I shall be brief. One is the need to emphasise a broad-based multidisciplinary knowledge foundation for the 21st Century, even at the expense of some specialised knowledge. I shall just quote one example for your reflection. I have learnt that M.I.T. has recently required all first-year students (science, engineering, social science, etc.) to take a course on biology. Contrast this with the local situation where "A" level students—other than those in the medical stream—do not study biology, and even some "O" level students are allowed to drop biology! Such an early specialisation will constrain unduly the development of a flexible and adaptive workforce when the economic environment and opportunities undergo major changes.

Systems thinking. The other important consideration is the need to teach "systems thinking" as an important component of higher order thinking skills to deal with complex real-life problems. A relevant and familiar example is the following. All teachers want to do their job well and give a great deal of homework to the students. The teachers may be satisfied when the students return good grades. At the systems level, however, we may find that this is poor education if the students, being over-pressured, cannot find time to develop social and other necessary non-academic skills. A worse consequence

may be that the students' interests in learning are "killed" in the process! Teachers who are familiar with systems thinking should be able to identify these possible pitfalls and thus plan accordingly. Experts now believe that the elements of systems thinking should be taught even in primary schools!

III. IMPLICATIONS FOR NON-ACADEMIC DEVELOPMENTS

Emotional intelligence. While innovations in teaching and assessment methods will improve the students' intellectual and technical capabilities, a sustainable outstanding performance in the workplace of the 21st Century will require that individual team members possess what the experts call "emotional intelligence" (measured by emotional intelligence quotient, or E.Q. in short). Emotional intelligence includes self-awareness and impulse control, persistence, zeal and self-motivation, empathy, and social deftness. It determines how effectively individuals perform in groups and complements traditional roles of rational intelligence (measured by intelligence quotient, or I.Q. in short). Outstanding organisations of the 21st Century need "star" performers who possess both high I.Q. and E.Q., in addition to strong teams of knowledge workers.

Let me elaborate on the quality of "star" performers. The world renowned Bell Laboratories in the USA attracts scientists and engineers who are all at the top on academic I.Q. tests. But within this pool of talent, some emerge as stars, while others remain average in their output. What makes the difference between stars and others is not their I.Q.s, but their E.Q.s. Star performers are better able to motivate themselves, and work their informal networks into ad hoc but winning teams. The "stars" were studied in one division of the Labs, whose sophisticated work required teams ranging from 5 to 150 scientists and engineers. No single person knew enough to do the job alone; getting things done demanded tapping other people's expertise. The study report, published in Harvard Business Review, clearly indicated that a middle performer often had difficulty getting the ad hoc team to solve an unanticipated problem; he painstakingly called various technical gurus and then

waited, wasting valuable time while calls went unreturned and email messages unanswered. Star performers, on the other hand, rarely faced such situations because they did the work of building reliable networks long before they actually need them. When they called someone for advice, stars almost always got a faster answer.

Besides networking, star performers also excel in other aspects of emotional intelligence. These include effective coordination, expertise in building consensus, ability to see things from the perspectives of others, persuasiveness, ability to promote cooperation, and a high level of initiative. Incidentally, I believe that the presence of such star performers can help us solve one important problem in Singapore—that of job hopping. If we have star performers leading and building strong teams of knowledge workers of the future, the team members will find it more difficult emotionally to job hop for small gains elsewhere!

The challenge. In view of the importance of emotional intelligence in enabling effective teamwork and creating star performers in organisations of the future, the development of the basic skills of emotional intelligence should become an essential and explicit goal of university education, and academic staff must take up this challenge. The basics of emotional intelligence can be taught both in schools and in universities. Awareness and skills can be improved through special workshops conducted by experts.

However, we should realise that emotional intelligence cannot be fully developed and improved in the classroom alone. As in primary and secondary schools, non-academic aspects of university education provide better and more varied opportunities for personal growth, reinforcing societal values and responsibilities. Networking and teamworking are other components of emotional intelligence which can be more effectively enhanced through team sports, clubs, committee assignments and other extracurricular activities. I would venture to add that certain qualities such as determination, enthusiasm and passion which are strengthened in non-academic pursuits are also important in academic performance especially in research and scholarship.

Our academic staff should be urged to apply systems thinking themselves to fully understand that educational objectives incorporate both academic and non-academic aspects. As non-academic performance is difficult to assess and hence not graded, students have the tendency to focus their attention only on the academic aspects in order to score good grades. To optimise the entire educational experience, academic staff therefore need to play a critical role in guiding the students to pursue a more balanced educational experience for long-term benefits. I would like to further suggest that our academic staff apply the principle of concurrent engineering to the educational process/products—this will convince them to move upstream to work in partnership with schools to achieve synergy.

Finally, staff should have the shared vision to build a campus culture that makes the university a "caring community", a place where students feel respected and cared about, and experience bonding with classmates, academic staff and the university itself. Academic staff need to be role models and extend their care to and influence over the students. The university will then be well regarded as an outstanding national resource to serve the function of nurturing and strengthening both the academic and emotional intelligence of our students.

IV. CONCLUDING REMARKS

Formal staff training. All the necessary changes discussed above cannot be carried out effectively if academic staff are not well prepared to face the new challenges. To overcome resistance and instil enthusiasm, formal staff training in the fresh approaches to teaching, assessment and learning will be essential. The skills and attitude of staff in contributing to the non-academic aspects of education need special attention as staff performance in this area is hardest to track. University management will need to review the staff appraisal system to ensure that it rewards academic staff who have successfully negotiated the paradigm shift.

University staff will be encouraged to share their experience with our school-teachers, alert them of future changes, and provide feedback to help schools

be more effective. I hope my presentation today also communicates the message that the University appreciates the critical role played by schools and the cooperation should be further strengthened by more regular dialogue sessions.

Cultivating entrepreneurship. I have not touched directly on the interesting and important question of how we could nurture entrepreneurship. More of our graduates will become entrepreneurs as opportunities for new business ventures are created by the rapid technological revolution and the economic development in other parts of Asia. It is also recognised that the competitive advantage of a nation is significantly enhanced if the workforce and the leaders have entrepreneurial spirit and qualities.

It suffices to mention here that the nurturing of higher order thinking skills and the development of emotional intelligence all help potential entrepreneurs who will need these competencies to create new ventures and persevere in the face of ever-increasing competition. A person strong in emotional intelligence is unlikely to develop the "risk-averse (or kiasu)" attitude which would lead to negative consequences such as "unwilling[ness] to make a decision" or "not giving the new method a chance to be tried out".

It is also well-known that entrepreneurs are experts in networking. In this respect, the university will have another good reason to significantly increase the number of foreign students or provide more opportunities for local students to study abroad through exchange programmes. The friendship and the global networks thus developed will be very helpful to future generations of university graduates who subsequently become entrepreneurs and leaders.

I have focused on university education in my presentation. I believe, however, that much of what I have said is equally important to other post-secondary educational institutions which aspire to be learning organisations of the future. Let us all work towards producing learning environments which are exciting and creative for our students, equipping them to face the challenges of the 21st Century. ■

Thumbs Up for Project Work

Both practice and research increasingly confirm the usefulness of *project work* in effecting desirable learning outcomes. Properly designed and executed, project work can promote the development of higher cognitive and processing skills and inculcate in our students, among other things, intellectual curiosity, self-directed learning, intellectual rigour and tenacity, and mental exactitude and sophistication.

A survey of the various faculties at NUS shows that the use of project work is quite widespread, with considerable variation in form, magnitude, level of sophistication, degree of supervision and collaboration, and percentage of the curriculum. Within

the local context of a highly competitive educational system coupled with a tradition of terminal assessment by strictly invigilated performance at examinations, there are culture-specific conditions which preclude simple importation of practices used elsewhere and necessitate careful thought in their adoption and application.

The booklet on *Project Work*, the latest addition to NUS' *Handbook on Teaching*, considers some key issues. The booklet was distributed to all faculties in December. Please contact the CDTL office at 772 3052 if you have not received your copy. ■

Educational Television: NUS Programme Telecast Over SCV

Mr Joseph Peters, Assistant Director, CDTL

*T*hrough a special arrangement with Singapore CableVision (SCV), CDTL is currently producing half-hour programmes showcasing NUS' eight faculties for telecast over the EUREKA Channel, Singapore's only educational cable television channel.

Each programme will have a common three-part structure. The first segment covers a faculty in general, the second highlights some aspect of that faculty's work that has educational significance for the general public, and the third "Newsflash" segment informs the public of significant events (past, present or future) at NUS.

The programmes are being televised, one every two months, through 1996 and 1997. Other

educational programmes produced by CDTL (and the former CET) and selected from the Centre's archives, are aired during the intervening months.

The EUREKA Channel was officially launched in August 1996. It aims to focus on "the academic aspect" for a growing target audience of upper secondary school students and young adults. As a preview to the launch, CDTL provided a programme on "Preparing for Higher Education" which was telecast in July to coincide with the start of the new academic year.

In September, the Faculty of Architecture and Building programme was aired, followed by that of the Faculty of Arts and Social Sciences in October. The first in our series of archive pro-

grammes was telecast in November and the Faculty of Business Administration programme was featured in December.

SCV has agreed to air each of the programmes six times during the next two years. As SCV's viewership grows, so will exposure to NUS' achievements. This regular series of programmes should help increase the University's visibility and interaction with the community at large. ■

For information regarding future telecasts, please refer to the CDTL homepage: <http://www.cdtl.nus.sg>

INTERFACING WITH MULTIMEDIA APPLICATIONS

Miss Wong Yeng Yi, Educational Technologist, CDTL

With the incorporation of text, sound and graphics, multimedia is a different way of presenting information and in many cases can enhance the learning process. Currently, there are available commercially many multimedia titles (mostly in CD-ROM format) on various subject matter. These can be great resources for teaching and learning. However, there may be instances where commercial titles do not meet teaching objectives. In such cases, custom-made titles may be more effective. The design and development of custom-made titles is an area of great interest at CDTL.

There should be a distinction made between multimedia applications and electronic presentations. Both may employ the same medium and hardware but the use of each differs greatly. Applications used as teaching supplements are normally intended for self-directed use where the learner guides him or herself through the material contained within the application. Presentations, on the other hand, are normally given by one person and in a linear fashion.

The creation of multimedia applications is usually a collaborative effort between people with different skills. A typical team consists of a subject matter expert, an instructional designer, programmers/authors and visual designers.

The work consists of two major stages: design and development. The design stage entails the collection of the content material. Multimedia is often used in a non-linear fashion and requires special treatment from other mediums like print or video. Content material is therefore organised and presented with this in mind. The interface is based on the typical target user of the product and the intended implementation of the application.

The development phase comes into play when the product is materialised. Programming begins and the product is tested, packaged and eventually distributed.

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THE EFFECTIVE STUDENT

...a word to the students

Congratulations! You made it to NUS and are now an undergraduate. All those years spent in school and junior college have culminated in this. For most students, getting used to university life will take some adjustment. Not to worry. The University is here to help you make the transition and develop to your fullest potential.

The University's priority is to produce graduates who are equipped to confront the challenges of the 21st Century. By the time you graduate, you will possess a broad knowledge base and a wide range of competencies like critical and creative thinking, information processing, problem solving, communication and interpersonal skills. The successful graduate will also have a highly developed sense of moral integrity and social responsibility.

To ease your way into the world of higher education and to orient you to meet its demands, each student is provided with a self-paced study guide: *The Effective Student: A Guide to Higher Education at NUS*. This im-

portant resource is designed to help you adjust to the new environment and become a more effective student. It covers three main topics: 1) Orientation: Gearing Up to Higher Education, 2) Study Smart: The Savvy Student, and 3) Effective Learning.

Many students have found the Guide useful. Here's what some have said about *The Effective Student*.

"...it covers all aspects of a university student's life"

"...the effective learning methods are a great help"

"...helpful study tips"

"...useful, interesting and very applicable"

The Effective Student is distributed to all incoming students during orientation. If you haven't received your copy, call the CDTL office at 772 3052 or check out the CDTL web site at <http://www.cdtl.nus.sg/UFM> ■

The packaging of a multimedia application can come in various forms. The current, most common form is CD-ROM. It can be mass-produced rather inexpensively and can hold large amounts of data (approximately 650-680 Mb). Large data storage is often necessary if the application includes video and sound clips. The Internet is also fast becoming another medium used for multimedia learning.



"Gross Anatomy", a joint project between Dr K. Rajendran from the Department of Anatomy, the Computer Centre and CDTL.

CDTL is currently working on several multimedia projects, some of a promotional nature and some for teaching. One promotional project on CD-ROM introduces the Science Faculty and will be used for student recruitment.

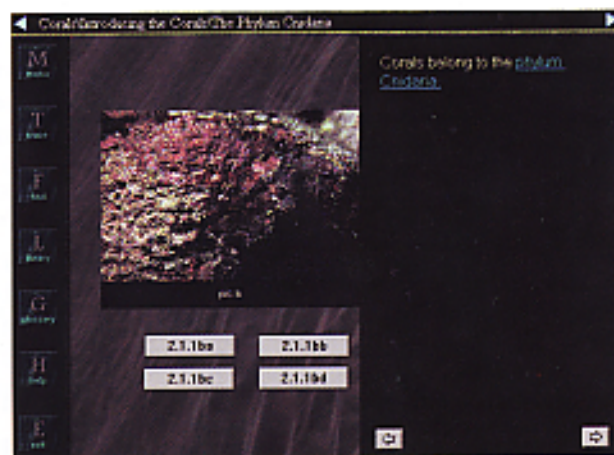
Another multimedia application is being developed in collaboration with the Reef Ecology Lab and Professor Chou Loke Ming. This application is intended to supplement students' learning of coral reefs, especially those found in Singapore. It also contains information on reef management and conservation.



"The Effective Student" guide on the Web.

The Centre is also exploring use of the Internet to disseminate teaching material. Our pioneering project is placing CDTL's publication *The Effective Student* on the Web. Although the pages do not contain media clips, web design is similar to that of CD-ROM in that it is user-directed and requires similar planning.

Until we build enough infrastructure within CDTL to allow us to take on more projects, our office will be most beneficial to individuals able to create and maintain their own applications. To help make this possible, we have started conducting introductory workshops on developing multimedia applications and on instructional design. The former introduces the nuts and bolts of materialising a product and the latter deals with handling the planning and cognitive aspects of the product. ■



The interface for multimedia applications should allow for non-linear exploration and navigation.

CDTL

The Centre for Development of Teaching and Learning (CDTL) provides a range of facilities and services to support the teaching and research programmes of the University.

These include: teaching and learning support, research on educational development issues, instructional design and development, instructional media, video teleconferencing and computer imaging.

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