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Using new media

By Clara Chung-wai Shih and David E. Weekly

EDUCATIONAL PRACTICES SERIES-15

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Series preface

This booklet shows how to use new media and technology (i.e. computers, the Internet, on-demand printing and related technologies) and electronic media for educational applications. It has been prepared for inclusion in the Educational Practices Series developed by the International Academy of Education and distributed by the International Bureau of Education and the Academy. As part of its mission, the Academy provides timely syntheses of research on educational topics of international importance. This booklet is one in a series on educational practices that generally improve learning.

The authors are distinguished young scholars:

Clara Chung-wai Shih is the founder and executive director of Camp Amelia Technology Literacy Group Inc., a non-profit organization dedicated to promoting universal literacy through the creation and distribution of free open-source educational software. A native of Hong Kong SAR, Clara recently graduated from Stanford University with a Bachelor of Arts and Science degree in Computer Science and Economics, as well as a Master of Science degree in Computer Science. Having worked on the strategy team at Google Inc., Clara recently began her master's degree study in Electronic Learning at Oxford University in the United Kingdom. Clara recently spoke at the seventh Human Service Informational Technology Applications in Hong Kong and the Education Without Borders Conference in Abu Dhabi, United Arab Emirates.

David E. Weekly is the founder and chief executive of Coceve, a technology start-up company in Silicon Valley. As also the founder of the non-profit California Community Colocation Project, David provides free high-speed Internet access for hundreds of organizations and individuals around the world. David obtained his Bachelor of Science degree in Computer Science at Stanford University. Clara, David and three other educators taught over 100 children about computers and technology in Accra, Ghana. The programme was extensively covered on television, radio and newspapers, including Pravda in Moscow. Their insights from this computer teaching experience formed the basis for much of the material in this booklet.

Scholars from three continents reviewed the booklet: Que Nguyen, Shirley Somuah, and Daniel Zarzar. A refugee from Viet Nam, Que has mastered both computers and the English language in just two years and is a graduate student in mathematics at the Colorado School of Mines. Born and schooled in Ghana, Shirley Somuah is an undergraduate studying Management Science and Engineering at Stanford University. Daniel Zarzar, originally from Guadalajara, Mexico, completed his B.S. in computer engineering from El Instituto Tecnológico de Estudios Superiores de Monterrey. He currently works as a technical programme manager at a large software firm in the United States of America.

The officers of the International Academy of Education are aware that this booklet is based on research carried out primarily in economically advanced countries. The booklet, however, focuses on aspects of language development and teaching that are universal. The practices presented here are likely to be generally applicable throughout the world. Indeed, they might be especially useful in countries that are currently less developed economically. Even so, the principles should be assessed with reference to local conditions, and adapted accordingly. In any educational setting or cultural context, suggestions or guidelines for practice require sensitive and sensible application, and continuing evaluation.

HERBERT J. WALBERG,
Editor, IAE Educational Practices Series
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Introduction

Books have existed for centuries, helping bring knowledge, religion and imagination to all corners of the world. The invention of the printing press in the 1400s revolutionized the manufacture of books, making them increasingly affordable and available. Yet, for all their advantages, books have several important drawbacks: for instance, they are difficult to revise and expensive to publish, print and distribute.

Recent advances in technology have enabled electronic media to offer a useful alternative to the printed book. Electronic works can go beyond the printed word, offering not only text, but sound, colour, animation and interactivity, thereby putting users in control of their own experience. Not only can electronic works be distributed freely and instantaneously through the Internet to connected destinations worldwide, but inexpensive and lightweight CDs also make it possible to send whole libraries of material inexpensively to any place on the planet. These CDs can be cheaply and quickly reproduced and redistributed in their turn, also empowering recipients to become redistributors. As an example, a library that received a single CD with the texts of hundreds of books could quickly and cheaply distribute copies of the CD to its reading clientele.

The continued spread of technology throughout the world is making computers an increasingly practical tool for enhancing youth education. While the poorest areas of the planet do not yet have abundant computing resources, the rapidly falling cost of computers combined with continued increases in Internet access is likely to make universal computer access soon a reality. Against this backdrop of widespread computing, we would like to give an overview of immediate steps that can be taken to use technology to enhance children's education worldwide.

Along with the power granted by these technologies comes new responsibility. As users in this new electronic world, we must abide by a code of conduct that includes respecting writer's rights and taking care to screen content for children against harmful materials, such as pornography or violence.

We hope you find this booklet useful!

Clara Shih and David Weekly

1. Distribute media electronically

Agencies can employ a mix of electronic media and traditional print media to reach as many educators, tutors and students as possible, while minimizing cost.

Research findings

Because of the high costs of shipping printed materials, electronic distribution can offer a wide selection of content while saving money. Educational leaders can choose the most appropriate content for their purposes and programmes.

Practical applications

Selected materials can be electronically distributed and then locally printed in education centres, schools and libraries. Traditional print distribution can be helpful in many locations where staff lack resources, do not know how or do not feel comfortable accessing these materials in electronic form.

There are two levels at which materials can be selected: centrally and locally. Central selection is more appropriate for countries and localities that require a uniform curriculum. Local selection is more appropriate for areas where local leaders, educators, tutors and students can themselves make the choices that best fit their distinctive purposes, conditions and preferences.

There are three main areas of focus in considering electronic distribution of materials.

1. **Selection**—*picking what material to make available*
   We encourage a wide selection encompassing many disciplines and teaching methods (Section 7 goes into greater detail) presented in small, quickly downloaded, universally accessible formats such as text (TXT) and hypertext mark-up language (HTML), in favour of larger formats such as portable document format (PDF) and Microsoft PowerPoint (PPT). Many poor communities have low-speed Internet connections, slow computers, or both.
2. **Cataloguing**—*letting users search the selected materials*
   There should be a quick and easy-to-use search mechanism where those wishing to access materials can either search for specific keywords or browse materials by category.

3. **Delivery**—*getting the selected materials to users*
   Providers should consider two content delivery mechanisms: CDs (or DVDs) and the Internet. CDs have an initial cost for production and shipping, but afford greater convenience for end-users, as many locations have computers that can use CDs but have no Internet access. Please see the following two sections for more information about when to use CDs and when to use Internet-based solutions.

2. Use CD/DVD

CDs offer substantial storage capacity and can be used again and again without requiring Internet access.

Research findings

Most computers in the world today are not connected to the Internet, because it is unavailable or too expensive. Most computers can, however, read CDs or DVDs. They can store more than 300,000 pages of text. (Though less widely available, DVDs can hold even more material.) Enhancements such as sound, colour and animation take up more space than text but, given the vast amount of storage available even on a CD, it is easy to include them in addition to the text. CDs can be used by many different people and as many times as is needed; as long as they are not badly scratched, they can last for years. CDs can also be easily copied (also called 'burned') with a special 'CD burner', which comes with most CD drives in new computers. Data can generally be read from a CD faster than they can be read from the Internet, especially if Internet access is slow or not always available.

While there is a small amount of cost to produce and distribute CDs, the distribution costs are much less than for print, as a CD weighs less than any small booklet. CD shipping costs compare very favourably to print: shipping thousands of books costs hundreds of times more than shipping a single CD that contains far more text. CDs must be handled carefully; scratches and exposure to sunlight can cause some or all sections of the CD to become unreadable. One disadvantage of using CDs is that change to the source material may require the production and shipment of a new set of CDs. As such, Internet-based content may be more appropriate for information that is frequently updated, such as news. (See the following section.)

Practical applications

1. **CD versus DVD**
   Most DVDs can store seven times as much information as a CD. But while DVD readers can also read CDs, CD readers cannot read DVDs. Most computers have CD readers, but not only do less than half of North American households have a

DVD reader, less than 1% of households in India and Sub-Saharan Africa have access to DVD readers. If the goal of a project is to produce material that is as widely useable as is possible, it is probably better to use CDs than DVDs, even if it will require several CDs to hold the same amount of material.

2. **Sharing**
   The ease with which CDs may be copied suggests an easy model for sharing that has already been mentioned in the Introduction: after a school receives a CD, it can make copies of the CD or print paper copies for students, parents, teachers and other schools. There is no limit to the number of copies that can be made from a single CD; those copies, in turn, may also be copied indefinitely. It is, however, recommended that providers of CDs send several copies to recipients in case some disks are lost or broken. For the same reason, recipients of CD media should try to keep at least one copy of a CD in a safe place in case the original disappears or becomes unusable.
3. **Handling**
   To prevent CDs from becoming unreadable, they must be handled carefully. Sunlight, heat and scratches can all destroy a disc. CDs should ideally be stored in a cool, clean and dry environment at 16-21°C (60-70°F). Discs should be stored inside protective plastic or paper 'sleeves' to help reduce the likelihood of scratches.

3. Use Internet media

Enable easily updatable, scalable, customized information exchange with an Internet website.

Research findings

Internet distribution solutions can be said to use a 'client-server model'. Content providers offer files and web pages from a central 'server', and web browsers on users' computers act as 'clients' to browse and download selected information from the server. For users with Internet access, this model is a very fast and cheap way to obtain content.

Using the Internet for distribution not only makes it easy to update information and publish to a wide audience, but this information can be customized to individual users' tastes—users can even be permitted to publish their own information, since it lets them post comments on materials or add new materials to the server. Updates are simple because the organization responsible for the website can make changes even after the information has been posted on the server, and clients that access it can see the change. Websites can be customized to detect a user's country and region, allowing a user automatically to receive information in the appropriate language. With print media and CDs, information is 'broadcast' in one direction: from the content provider to the recipient. The Internet, on the other hand, enables immediate, two-way interaction; websites can be designed to respond in certain ways based on what messages users type or what they click on to select.

Practical applications

Although many potential users do not yet have Internet access, those that do can benefit from robust and well-designed websites that are accessible to users with slow Internet connections, but also have enriched materials for those with high-speed Internet connections. There are three important considerations in providing a website:

1. **Sensitivity to low-speed connections**
   When storage is a limiting factor, use universal formats that have small file sizes, namely TXT and HTML. The HTML

format in particular affords a rich set of fonts, backgrounds and colours while requiring minimal storage space; it is the building block of most Internet pages. Portable document format (PDF) is more appropriate for situations requiring texts, images, layouts or arrangements to be preserved in the document.

2. **User interface**
   Once content has been determined, employ experienced web interface designers who follow accepted design practices, such as minimal clutter, intuitive operation and feedback.
3. **Hosting**
   Typically, organizations will employ web designers to build a website to their satisfaction, then transfer the web files that have been created to a third-party hosting service to maintain servers. The web pages then remain accessible twenty-four hours a day, seven days a week, to 'serve up' the website whenever someone wants to access it from anywhere around the world. Websites are referenced by a unique 'universal resource locator' or URL. Domain names (such as http://www.learntoread.com) can be leased for one- or two-year intervals.

4. Encourage reading on screen

Digital formats, including hypertext and multimedia, support contextual learning.

Research findings

Digital media, either online (Internet-based) or offline (from floppy disks or CDs), that enable reading on computer monitors have the advantage of being multimedia and thereby the potential to be highly engaging. For example, hypertext facilitates non-linear learning, which can have special appeal to non-traditional learners. As another example, chat rooms or instant messaging with teachers or peers provide yet another communications medium for students.

Limited availability of computers, however, may provide a challenge in offering all children in an area the ability to use such on-screen tools.

Practical applications

Having both high-quality content and efficient dissemination of that content is important in any education programme. While freely available websites like Google and Wikipedia have their merits, students may learn best when using software and content developed for their respective age groups.

Computer-based reading can offer automated evaluation and progress-tracking of reading comprehension, better accommodation for the diverse starting points and paces of different learners, and rapid, consistent feedback. Moreover, younger people may more readily and comfortably read on screens than adults who may have been trained to read books.

With digital media, it is possible to include images, diagrams, sound and even video alongside text; but there may be some disadvantages to doing so. Audio and visual elements require much more digital storage space than text; adding such elements to text increases download times and can limit the number of works that can be put on a CD. A single photograph can consume as much digital storage as a book!

In most cases, however, adding a small number of graphics or sounds is not only acceptable, but desirable, as images and sounds can quickly explain difficult concepts and make material more appealing to students. But between the added complexity of editing

documents with graphics and the increased cost of distributing 'media-rich' files, we recommend that graphics and sound be used in moderation and only where they significantly enhance the understanding and appearance of the text they accompany.

5. Select appropriate materials using proven methods

Recipients of content can use simple, easy-to-calculate formulae, such as Dale-Chall and Flesch-Kincaid, to select the best portfolio of materials for their students.

Research findings

Textbooks and instructional materials may have a great an effect on children's learning. Fortunately, a number of accepted guidelines for selecting appropriate materials exist to aid parents, tutors and educators in selecting appropriate materials for students once the content has been made available on CD or the Internet. The basis for most formulae is that shorter, more common words and shorter sentences are easier for younger students to read.

By having a computer automatically evaluate the reading difficulty of pieces of text and suggest reading material for a class or even an individual pupil, pupils may be provided with material that is best suited to their current skills and is most likely to advance their understanding.

Practical applications

There are several methods that a computer can use to judge the readability of pieces of text. Most of these, like Dale-Chall and Flesch-Kincaid, examine basic statistics about the document, such as the average word length, average sentence length and average paragraph length. These can be found on the Internet for calculating the appropriateness of content for students of various ages and abilities.

Once a computer can roughly assess how difficult a piece of material is, a teacher or school administrator can declare a certain range of difficulty appropriate for a given grade level or classroom. Educators, tutors and children themselves can provide insight about text difficulty and match content to educational purposes and students' interests.

6. Teach computer use when possible

Young people adapt quickly to new technologies and can use them to enhance their learning.

Research findings

Studies show technology should be taught more as a means for learning than as a primary end in itself. When resources are available to provide computer access, computers can be an invaluable aid in teaching and learning. Educators must understand what the technology and software can and cannot do, and incorporate computers accordingly into the existing curriculum. As an additional benefit, computer proficiency is a valuable skill that is likely to help students become independent learners and knowledge seekers, as well as enhance their long-term earning potential. Many universities require or presume computer proficiency of admitted students.

Practical applications

Many schools cannot afford to provide computer access even if the computers themselves are affordable, as maintaining a computer costs more than purchasing one. It can also be very difficult to find skilful computer teachers, since many individuals can earn better money on the open market.

Therefore, educational administrators should focus not just on obtaining computers but also on putting good software and materials on those computers. A big problem at many computer-equipped schools is students' preoccupation with computer games instead of educational applications. We recommend schools use pre-selected educational websites and applications to help focus students' learning. In particular, we recommend the following websites (current as of May 2005):

Reading

- Beck Learning: http://becklearning.org/-*Site dedicated to youth literacy.*
- The Online Books Page: http://digital.library.upenn.edu/books/
- BiblioMania: http://bibliomania.com/
- The Internet Public Library: http://www.ipl.org/

Maths & Science

- A+ Math: http://www.aplusmath.com/Flashcards/ *Flash cards for addition, subtraction, multiplication, division and basic algebra.*
- MathCats:http://www.mathcats.com/microworlds.html *Math games for children.*
- Chem4Kids: http://www.chem4kids.com/
- Ask Dr. Math: http://www.mathforum.org/dr.math/

News

- Google News: http://news.google.com/
- Wikipedia Current Events: http://en.wikipedia.org/wiki/Current_events
- Children's Express: http://www.childrens-express.org/

Search

- Google: http://www.google.com/
- Yahoo!: http://www.yahoo.com/

7. The trends are in technology's favour

Global trends in technology and the economics of technology are bringing the costs of computers and computing down.

Research findings

Several recent phenomena are helping to make high-quality, highly available technology available worldwide. One concerns hardware and is called 'Moore's Law'—the other concerns software and is called 'Open Source'. While wholly separate, they both are achieving the same end of affordable computing for all.

Moore's Law is named after Gordon Moore, a computer-chip engineer. He predicted that every year and a half, computer chips could get twice as fast. Even though he made this prediction over twenty years ago, it has held remarkably true for the time since then. As new computer chips get faster and faster, the old chips get cheaper; the cost of a 'good, cheap, new computer' has fallen five-fold in the past ten years. If this trend continues, reasonably good computers will be affordable to an increasingly large number of people in the world.

Open Source is another fascinating phenomenon in the development of computer software. A very large number of computer programmers worldwide have decided to use their free time not only to create pieces of software that they will give away without cost, but also to give away the instructions and source codes that create the software. When they do so, other programmers find and fix problems with their instructions, as well as add new features to the software. Oftentimes, an important piece of software will have literally hundreds of contributors.

In this way, problems are fixed quickly and new features are added on a regular basis under the undirected co-operation of a large number of programmers around the world. While it sounds like a crazy experiment, this development model is actually responsible for most of the software that runs the Internet today! The Open Source community developed almost everything, from the way electronic mail (e-mail) is handled to how web pages are served. Needless to say, some commercial companies are not happy about this trend, since they would like to have people paying for all software. But for

poor areas, the opportunity to use powerful software free of charge is compelling.

Practical applications

There are an increasing number of Open Source software packages that can be very useful to a school. Here are but a small number of the powerful, free pieces of software that can be used in place of expensive, commercial software at a school:

- For browsing the web: **FireFox**
  http://GetFirefox.com
- For composing documents: **OpenOffice**
  http://OpenOffice.org
- For reading & writing e-mail: **Thunderbird**
  http://GetThunderbird.com
- For making PDF documents: **PDFCreator**
  http://sf.net/projects/pdfcreator
- For editing photographs: **Gimp**
  http://gimp.org

8. Conclusion

The findings and practical applications presented here offer hope that computing for education will become an increasingly affordable reality for much of the world. Specifically, distribution of educational material can be made much more powerful and customized through electronic distribution. Whole libraries of tens of thousands of books can now be shipped more cheaply than a single, cheap paperback.

Once the information reaches its destination, it can then be quickly replicated and sent elsewhere, enabling the spread of information to be like nothing the world has ever seen before. Even in cases where computers are not readily available to teachers and students, as explained here, the Internet and CDs provide the practical possibility of making paper prints locally.

Increasing access to low-cost computers and free software in education will do much to enhance the worldwide education of youths and adults alike. We foresee the potential for the next generation of students to finish their schooling fully literate, comfortable with computers, and as thriving members of the information society.

Glossary

Brief descriptions of technical terms used in this booklet.

Bidirectional—literally 'two way'. When information can be not only passively absorbed but also published by an end user. Television is not a bidirectional medium, but Internet terminals are.

Browser—a software programme for network-connected personal computers, such as www.yahoo.com, that lets a user display, navigate and print web pages.

CD-ROM—stands for **C**ompact **D**isk, **R**ead-**O**nly **M**emory, or just **CD** for short. These five-inch wide circular disks can contain a great deal of information and can be cheaply produced.

Chatrooms—when a group of people in different locations use a piece of software to see what the others are typing to the group. If one participant types 'Hi! How is everyone?', everyone using the software sees the message. It's as if everyone were in a kind of 'chat' room, speaking out loud.

Client-server model—a configuration where a user's 'client' computer connects to a centralized server via a network like the Internet or a telephone line. The server keeps track of the user's preferences and information and makes them accessible from many different clients.

DVD-ROM—stands for **D**igital **V**ersatile **D**isk, **R**ead-**O**nly **M**emory, or simply **DVD**. These five-inch wide circular disks are similar to CDs but, since they were invented a decade later, they can store much more information. They are cheap to produce, but not quite as cheap as CDs.

Google—a company in the United States that runs a free service to let people search for information on the Internet. Google is one of many such 'search engine' companies, but it is at present generally considered the best at quickly producing useful and relevant results without displaying lots of advertisements. See: http://google.com/

Hardware—the physical components that make a computer work, like memory and a processor.

HTML/hypertext—stands for **H**yper**T**ext **M**arkup **L**anguage. This language specifies a series of simple 'markups' that can be applied to text, such as making a certain word bold, or telling the browser to take a user to a different web page when a certain image or word is clicked.

Information society—the concept that modern society is starting to revolve around the production, modification and distribution of information, as opposed to manufactured goods.

Instant Messaging (or **IM)**—a kind of computer programme that lets two people type immediately to each other. Every line of text one user writes is immediately displayed to the other. Users can keep 'buddy lists' that show when their friends are online and using the program. 250 million people use IM!

Internet—the network that connects all public computer networks in the world. It is a 'network of networks', acting as an 'inter-network' connection; hence 'Internet'. There are literally billions of pages of information on the Internet, nearly all of which are freely available to anyone with a computer.

Multimedia—materials encompassing not only one medium—like text—but also pictures, movies/videos and sounds.

Non-linear learning—a learning style where a student can explore topics in the order of their choosing. Typically, this level of personalized teaching was only available to those pupils who could afford it, but today anyone with a computer and access to learning materials can engage non-linear learning.

Non-traditional learners—many students don't learn effectively in a 'traditional' environment, where students take notes as a teacher talks at length. Students who engage new environments, such as computer learning, are considered non-traditional learners.

Scalability—being able to apply a technique or concept widely without too much difficulty. You may know someone who can cook a wonderful meal, but it might be difficult for them to open hundreds of restaurants, because the skills involved in running hundreds of restaurants are very different from those required for cooking a family meal; individual cooks don't 'scale' well.

Software—computer programmes that can be stored and run on a computer. Software can be installed by downloading it from the Internet or by copying it off of a CD.

TXT—a plain text format readable by any computer without special software. TXT files only have basic formatting and cannot, unlike HTML, specify that a word be bold or 'clickable'.

Wikipedia—a free, non-profit website that acts as an encyclopedia and that, amazingly, lets every visitor modify any page they like. Websites that act like this are called **Wikis**, so the name comes from Wiki + Encyclopedia.

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EDUCATIONAL PRACTICES SERIES-15

The International Bureau of Education-IBE

The IBE was founded in Geneva in 1925 as a private institution. In 1929, it became the first intergovernmental organization in the field of education. In 1969, the IBE joined UNESCO as an integral, yet autonomous, institution.

The IBE acts as an international centre in the area of the contents and methods of education, with a special emphasis on curricular development. This is carried out through three basic programmes: (a) capacity-building; (b) policy dialogue; and (c) a resource bank and observatory of trends. The IBE also has a number of programmes that cut across these three basic programmes, such as its Clearinghouse for Curriculum Development on Education for AIDS Prevention. At the present time, the IBE: (a) organizes sessions of the International Conference on Education; (b) manages *World data on education*, a databank presenting on a comparative basis the profiles of national education systems; (c) organizes regional courses on curriculum development; (d) collects and disseminates through its databank INNODATA notable innovations on education; (e) co-ordinates the preparation of national reports on the development of education; (f) administers the Comenius Medal awarded to outstanding teachers and educational researchers; and (g) publishes a quarterly review of education - *Prospects*, a quarterly newsletter - *Educational innovation and information*, as well as other publications.

The IBE is governed by a Council composed of representatives of twenty-eight Member States elected by the General Conference of UNESCO. The IBE is proud to be associated with the work of the International Academy of Education and publishes this material in its capacity as a clearinghouse promoting the exchange of information on educational practices.

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