INTERNATIONAL JOURNAL OF INSTRUCTIONAL TECHNOLOGY AND DISTANCE LEARNING

July 2005
Volume 2 Number 7

ISSN 1550-6908

PUBLISHER'S DECLARATION

The International Journal of Instructional Technology and Distance Learning is refereed, global in scope, and focused on research and innovation in teaching and learning.

The Journal was established to facilitate collaboration and communication among researchers, innovators, practitioners, and administrators of education and training programs involving instructional technologies and distance learning. The editors and peer reviewers are committed to publish significant writings of high academic stature.

The initial year of publication was funded by the TEIR Center, Duquesne University. The Executive Director of the Center, Lawrence Tomei, served as Publisher. Additional support was provided by DonEl Learning Inc. and freely donated time of the editors, and peer reviewers.

Donald G. Perrin
Executive Editor

International Journal of
Instructional Technology & Distance Learning

Vol. 2. No. 7.

ISSN 1550-6908

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Editorial

The Implosion of Knowledge

Donald G. Perrin

Internet tools have dynamically increased the power of research, analysis, and creation of new knowledge. Interactivity on the Internet began as response, chat, and dialog on listservs. It has been raised to new heights by conferences, blogging, and Wikis, audiovisual components, and powerful search engines from Google, Yahoo, MSN and others. These powerful tools, when properly used, provide accurate and current data in less time, and raise dialog on the Internet to the higher levels of the Bloom taxonomy. Many great scholars of this generation are moving from the isolation of the ivory tower to the information rich and collaborative environment of the Internet. Others are being virtually born on the Internet. Access to new ideas and the people who initiate them is multiplied exponentially.

Little Science, Big Science by Derek J de Solla Price, written in 1963, heralded the transition from individual to team research and development. Today collaborative skills are business essentials that are taking on global dimensions. Projects range from student groups in asynchronous online courses to global science and engineering development in virtual communities. As a result, product development cycles that used to take years are now accomplished in months.

Solla Price also talked of the “invisible college,” groups of innovators who discuss and develop ideas long before they are known to the public at large and even to their academic communities. Blogging provides an open forum for significant scholarly ideas. It opens the “invisible college” of innovators and intellectual leaders to the global learning community.

Solla Price discussed the exponential growth of knowledge and the impossible task of keeping indexes up to date. If only he could see what the Internet has done! Computer search engines maintain a current index of the global knowledge base, with tools for “in depth” searches that can drill down to a specific piece of information in a fraction of a second. I just wasted ten minutes searching my bookshelf for Solla Price’s book – without success (information overload). I typed “Solla Price” in Google, hit enter, and found 28,800 references in a third of one second. The fifth listed article was a Wikipedia article listing his publications and achievements.

The Wikipedia has its own answer to the explosion of knowledge. Every new publication (including this Journal) adds new information to the body of knowledge, but over 95% of information presented is redundant – it already exists in the global knowledge base. The Wikipedia is constantly updated, refined, and refereed by experts among its readers. It is a great example of “open source,” and is referenced in Stephen Downes article in this issue and in Thomas L. Friedman “The World is Flat: A Brief History of the Twenty-First Century,” 2005.

Technologies to manage redundancy are essential to counteract exponential growth. Object oriented computer programming is a way to package frequently used computer code as “objects.” In a similar manner, learning objects are frequently used knowledge components that can be combined by computer to create individualized lessons. Storing critical knowledge as learning objects can reduce redundant and irrelevant data so that instead of exponential growth of knowledge, the growth rate can be controlled. Perhaps one day in the future it will be possible to pare down or *implode* the knowledge base as we know it.

Editor's Note: Stephen Downes provides a foundation for interpreting current business models in e-learning and predicting change in the future. Trends and stakeholders are related to factors that will determine their growth and / or demise. Technology is a stimulus for change, and attempts to privatize knowledge or otherwise control this market may be only a temporary phenomenon. Paradigm change, technological innovation and digitization of content are flattening the landscape for stakeholders in knowledge-based industries.

Invited Paper

The Economy of E-Learning

Stephen Downes

July 10, 2005

A reader writes:

> *I just finished a PhD in elearning, and I'm looking for my next steps. Thankfully I have many options but I realize that elearning looks more like a non-profit, charity sector than a normal, economically-viable activity. So I'd like to ask you a question: Where do you see the money being made in elearning today?*

Current Economics

There are three major sectors to the education economy as it currently exists:

- service provision
- educational content
- infrastructure

Service Provision

This is the actual delivery of educational services. It is typically divided into a grade school level (kindergarten to 12) and college level (colleges, universities, etc). There is in addition large investment in corporate learning, and a large informal (uncredentialed) learning sector.

For the most part, service delivery for schools and colleges exists as a public enterprise, though in some jurisdictions (especially the United States) there is a significant private sector involvement as well. Corporate learning is often delivered by the corporation, though many contract such services to external agencies. The informal sector is almost exclusively the domain of the private sector, with some significant exceptions in the form of libraries, museums and learning centres.

- Revenue for the public service sector is derived from (in decreasing order of magnitude):
- direct public funding, e.g., school budgets, grants to colleges and universities
- tuitions and other direct charges to users
- gifts and grants
- royalties and other earnings

Revenue for the corporate service sector is derived from:

- corporations
- tuitions and other direct charges to users

Revenue for informal learning is derived from:

- tuitions and other direct charges to users
- direct public funding, e.g., library budgets, grants to museums
- gifts and grants
- royalties and other earnings

This revenue is typically dispersed internally through staff salaries. Contracting of educational services to external agencies is minimal (though not zero). Most dispersements are in the form of salaries to employed staff, with a remainder contributed toward content and infrastructure.

The service provision sector is heavily regulated. Even where there is private sector involvement, there is a (typically) rigorous accreditation process to be undertaken. Staff are in addition regulated; there is an expectation of certain credentials (teaching certificate at lower levels, Masters and PhD at higher levels).

Educational Content

This is the production and distribution of educational content, for example, textbooks, workbooks, supplies (such as lab kits), displays (such as wall maps), and the like. The bulk of such content is produced by private enterprise, often in accordance with guidelines and criteria specified by the purchasing institution.

Revenue for purchases of educational content is derived from (again, in decreasing order of magnitude):

- direct public funding, e.g., school budgets, grants to colleges and universities, library budgets, grants to museums
- corporations (for corporate learning)
- direct purchases by users
- gifts and grants

The content provision sector is for the most part unregulated, with the exception of copyright regimes. The selection of material is usually made on a competitive basis, with purchase decisions being made in almost all cases (except informal learning) by the educational institution (or governing board) or the corporation.

Infrastructure

This is the production and, in some cases, maintenance of educational infrastructure. The major component here consists of educational buildings and associated expenses such as heat and cooling, power, fixtures, furniture and maintenance. It includes educational equipment, such as phys ed equipment, lab equipment, office supplies, and increasingly, computer hardware and software. Virtually all infrastructure is provided by private contractors, with some functions (especially maintenance) being handled in-house.

Revenue for infrastructure follows a by now familiar pattern:

- direct public funding, e.g., school budgets, grants to colleges and universities, library budgets, grants to museums
- corporations (for corporate learning)
- gifts and grants

Summary

What should be clear from this brief overview is that:

- there are numerous areas of economic activity in education
- that direct educational purchases form only a small part of that activity
- the bulk of educational expenses are borne not by the learner but by institutions - government and corporate

Impact of the Internet

The internet impacts this picture in a number of areas. It changes the nature of service provision, content, and infrastructure, creating new spending in some areas and decreasing spending in others. The expectation, typically, is that on a per-student basis, costs will decrease, however, it is also expected that because of increased efficiencies, the overall market will increase.

In general, the internet has the following impacts:

- digitization - many assets that existed as physical assets are now digital assets, with economies realized from that
- disintermediation - in many cases, intermediary management and administrative bodies are no longer required
- capacity - the productive capacities of individuals and groups is increased, reducing the need to contract specialized services

Service Provision

Although the major sectors of learning (public school, college, corporate, informal) are expected to remain as such for the foreseeable future, many of the administrative structure associated with these sectors will change. In general, because of disintermediation and increased capacity, there is likely to be much greater self-management of learning. This will result in an increase in informal learning, and in traditional (public, college, corporate) learning acquiring many of the characteristics of informal learning.

It does not follow (and should not be seen to follow) that the funding for such services will change to any great degree; institutions (governments and corporations) will continue to foot the larger part of the bill. Users are currently contributing to the cost of learning pretty much at the limit of their economic capacity (arguably, beyond their capacity, with education being unaffordable to large segments of the population, especially in developing nations).

The shift from formal and structured learning organization will be gradual, as the locus of funding (in the institution) places a natural constraint against the devolution of decision-making capacity from the provider to the user. In general, for such transfers to occur, a case will need to be made as to the increased effectiveness and efficiencies of self-managed learning. It is likely that this case will be made on a sector-by-sector basis.

That said, we are beginning to see evidence of this shift, from charter schools and home schooling, the already established and increasing network of certification exams, to Prior Learning Assessment and Recognition (PLAR), to e-portfolios, to degree transfers, educational consortia, and other menu-based educational approaches.

In general, the environment will change as follows:

- the delivery of learning through direct teaching will gradually shift to learning support through mentoring and coaching

- the structure of learning will be disaggregated, with a less clear division of classes and grades
- learning will become more personalized, with some individuals specializing at an increasingly early age
- rather than being mandated and scheduled, service delivery will be on an ad-hoc and on demand basis
- rather than being sole-sources, service delivery will be obtained from a number of institutions at any given time

As I said, this change will occur gradually as a result of a slow transfer of decision-making capacity from institution to learner. This will be accomplished in two major ways (which will typically be viewed as being in conflict with each other):

- by increasing the purchasing capacity of learners, as for example through a voucher system or direct per-student payment to institutions
- by decreasing the cost of learner services to individuals, as for example through the funding of learning centres and educational support services

Typically, the purchasing capacity approach is favoured by proponents of increased private sector activity in the learning economy, while the decreasing cost approach is favoured by those advocating a public service approach to learning. In fact, either approach can support either public or private sector involvement; instead, the greater the involvement of the private sector, the greater the need to a regulatory framework, since (presumably) funders will want to ensure that only educational expenses are supported through an educational grants or vouchers program.

That said, the structure of disbursements in such an environment is likely to remain unchanged. The bulk of expenses will be in the form of staff salaries, whether staff are employed by private or public education providers; it is exceptionally unlikely that a 'cottage industry' of individual educators will developed, except as contractors to major service providers (much in the way tutor contracts are handled today by, say, the University of Phoenix, or in the way guides are funded by About.com).

For independents and small producers, economic opportunities will exist in the following sectors (this list is suggestive, not exhaustive):

- online community and group facilitation
- community-based learner support
- community learning centre management
- online and personal mentoring and coaching, such as for example provided by Ensemble Collaboration
- niche applications and services, such as for example provided by LabMentors

Educational Content

This sector will feel the greatest impact from online learning. Because of digitization, disintermediation and increased capacity, it is likely that demand for commercial educational content will drop sharply. Already we have seen a great deal of educational content placed online, from public institutions (SchoolNet, the BBC, NYPL, MIT OpenCourseWare and thousands more). In addition, numerous educators are producing their own content. Finally, especially in the area of informal learning, learners are producing their own content.

This impact is exaggerated by factors working against commercial publishers. Though their costs decrease dramatically (since they need not purchase paper and plastic, and need not physically deliver resources), the nature of their product has changed into one that can be reproduced for fractions of a cent. Currently, a regulatory environment prohibits the reproduction of learning materials, however, it does not prevent these same economies from being available to people in the production and distribution of their own non-commercial material. Consequently, even if the commercial product remains untouched, it faces increasingly significant competition from the non-commercial sector. Probably the clearest example of this is Wikipedia, which has surpassed any commercial product, but products such as Google Maps and Google Earth, along with widely dispersed free content such as the Live 8 videos, show that this impact will be widespread.

One may easily envision the almost complete collapse of the educational content market in a very short time, even within a decade. Factors working against it happening sooner include substantial lobby support by commercial publishers, their membership on college and school boards, quality-assurance and quality-control concerns, existing (and increasingly broad) copyrights, existing royalty-holders within the educational system, lack of marketing and distribution for non-commercial content. None of these is sustainable on a long-term basis, therefore, as these factors wane, commercial educational publishing will wane as well.

The result will not be less educational content, but in all probability, more. As non-commercial content is more widely accepted, and as content creation tools become more widely available, cheaper (and likely free), and easier to use, more people will contribute content on a volunteer basis or as part of their current employment.

There will be a short-term market for software tools designed to produce content, distribute content, to manage content and to display content (by short-term, I mean about 3-5 years). A good analogy is the market for MP3 creation tools; in the Windows environment, there existed a proliferation of tools available for recording and storing audio content; these tools marketed for $30 - $60. However, with the development of a free and open source audio content creation tool - specifically, Audacity - the market for these tools disappeared. In blogging, we see a similar phenomenon: early bloggers desiring a tool would purchase Userland or Typepad, however, the free Blogger service essentially closed that market; similarly, the thriving market for Movable Type was significantly impacted by the free WordPress alternative.

Therefore, the spending on learning content will drop significantly over the next decade, with allocations shifting from the purchase of commercial content on a restricted license, to the production of content in-house for free or effectively free distribution; this content will be viewed essentially as a public service (and may eventually qualify for tax credits) and, in commercial environments, as a loss-leader for greater value-added services. For example, IBM is investing heavily in the production of Linux and other free and open source applications, and has shifted its business model from hardware and software sales to services and consulting. Smaller markets will open up for other companies in more specific niches; Vancouver-based Bryght, for example, contributes to the open source Drupal online community application, and generates income through support and service.

Specific markets, either publicly-funded, corporate-funded or (less frequently) purchaser-funded will exist in the following areas related to educational content (this list is suggestive, not exhaustive):

- content classification and indexing, especially with regard to quality evaluation, appropriateness ratings, and the like
- content linkages - that is, the association of one piece of content with another, previously unrelated, piece of content

- filtering and streaming services - what Robin Good calls the NewsMaster - such as for example provided by Shift Central and RocketInfo
- content production community facilitation and support (e.g., the role played by the principals of Firefox development)
- content production tool installation, maintenance and support
- marketing and other advertising functions
- content production, usually on a contract basis, on behalf of a public institution

Infrastructure

The provision of educational infrastructure is not only labour intensive, it is resource intensive. The price of resources is increasing, and as a consequence the major impact of online learning will be to push educational infrastructure into systems of organization that are more resource-efficient.

For example, though to all appearances the educational construction boom continues unabated - new schools, libraries, residences and the like appear almost daily - this boom is likely to ease as the cost of materials increases, and for significantly, as operation costs (heating, lighting, etc) and transportation costs increase. Indeed, in the construction industry in general, we should expect to see as much emphasis placed on renovation as on new construction; with the end of the housing boom and with transportation costs making suburbs unsustainable, city centres and existing, underutilized physical infrastructure will attain greater importance.

Because of the greater need for information and communications technologies, the market for hardware is likely to remain stable and even to increase. The production of computer hardware is not only labour intensive, it is also energy intensive. The world-wide market for computer components has also resulted in significant transportation costs. The labour differential will decrease over time (Friedman's 'flat world'), and transportation costs will increase, so consequently, it is expected that local production of hardware components will rebound, especially in regions with an existing resource base and with abundant sustainable energy, such as hydroelectric.

Software, as numerous commentators have already observed, is rapidly becoming a commodity, and at a pace even more accelerated than content, is rapidly becoming people can produce for themselves. There is no inherent constraint on the continued expansion of open source, though factors similar to those related to content - substantial lobby support by commercial publishers, their membership on college and school boards, quality-assurance and quality-control concerns, existing (and increasingly broad) copyrights, existing royalty-holders within the educational system, lack of marketing and distribution for non-commercial software - will ensure that the expansion of open source software is gradual. As noted above, there will be short windows for commercial applications, but since in most markets these applications will not be protected by software patents this window will be a short one (in the United States, patent protection will not protect the market, and the development of free and open source software, along with its economic advantages, will move offshore).

In general, therefore, with some few exceptions, the economics of infrastructure will shift from the production of new materials and services, to the support and improvement of existing or free materials and services, with the exception of computer hardware, which will shift to more local markets. In particular, the following economic opportunities will exist in infrastructure (this list is suggestive, not exhaustive):

- physical infrastructure conversion for community-based activities and services

- provision of community-based activities and services, support for locally managed activities and services
- new software, for short periods of time
- installation, maintenance and support of free and open source software
- hardware manufacture, especially in regions with abundant energy
- wireless and other bandwidth applications for less developed regions (towers, routers, etc.)
- hardware recycling and repurposing for., e.g., embedded computing applications)

Summary

As can be seen from the discussion above, the educational economy is shifting from what might be styled as a 'production' mode to what might be styled as a 'service' mode. In some cases, new production (such as buildings and other infrastructure) is neither efficient nor desired; in other cases (such as content and software), digital technologies are allowing production to be undertaken by the consumers themselves.

Although the locus of decision making is likely to shift from the institutional to the individual, there is no scenario that suggests any great change in the funding of educational resources, save perhaps the likelihood that both individuals and institutions will expect to spend (far) less for a given educational opportunity. No great increase in consumer capacity to spend on educational services and products can be projected, and while corporate and government support for learning will continue, because of the benefits to the corporation or society, this support is soft and will depend on continued economic health, something that can be counted on to vary.

Faced with the choice between providing the same type of education to a smaller number of people or adapting to more cost-effective educational organization, corporations and governments will opt for the latter, especially as it is demonstrated that these alternatives are effective (you will notice a lot of this latter research taking place in the field now). Consequently, economic opportunities will exist, not in the production of new goods that will not be purchased, but rather in the support and servicing of increasingly self-managed educational activity.

This does not mean educational ruin for the educational industry; quite the contrary. As the sector shifts as described, the per-person cost of learning decreases dramatically. This greatly expands the market. In the public sector, it involves being able to provide more specialized and higher education for a greater number of people. Moreover, it enables more governments, especially those in the developing world, to provide educational opportunities. In the corporate sector, it extends the range of corporate education from the Fortune 500 sector to the much large small and medium enterprise (SME) sector. Indeed, governments wishing to expand economic opportunity will begin to provide at little or no cost a wide range of learning opportunities for the SME sector; this process is beginning already in many jurisdictions.

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About the Author

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Stephen Downes is Senior Research Officer with the National Research Council of Canada in Moncton, New Brunswick. He works with the E-Learning Research group that is affiliated with the Council's Institute of Information Technology.

His principal work involves research and development in e-learning, working with institutions and companies to improve their competitive position in the industry, and outreach through seminars, workshops, and articles.

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Editor's Note: As the responsibility for learning moves from teacher to student, new patterns emerge based on student need and student choice. A hybrid course combines classroom and online instruction. When online instruction is available in the campus teaching and learning center, assistance is available when needed. This paper studies the unique role of these centers in supporting learner needs.

The Chimera Course and Use of the Learning Center for its Emergency Hybridization

Ruth Robbins, Erin Hodgess,
Merrilee Cunningham, and Deborah Buell

Abstract

One of the popular concepts about problem-solving and critical theory has to do with destabilizing binaries, destroying the notion that a course is necessarily delivered face-to-face or online. This article depends for its philosophical stance on a university administration and faculty able to admit to the possibility of different levels of contingency hybridization of a course, in relation to the opportunities offered through the proliferation of the teaching and learning center from the major research university to a broader based even urban commuter university. Thus a chimera course would have different students delving into the same course with different percentages of online and f2f elements and would have the teaching and learning center providing backup.

Introduction

Theoretically, one of the popular notions about problem-solving and critical theory of late has to do with destabilizing binaries -- moving away from simple either / or categories such as categorizing a course as delivered face to face or on-line. This article depends for its philosophical stance on a university administration and faculty able to put away notions of stable binaries and admit to the possibility of different levels of contingency hybridization, not only for disaster recovery, as we have suggested elsewhere in print, but also in relation to the opportunities offered the student and instructor through another relatively new phenomenon -- the proliferation of the teaching and learning center from the major research university to a more broad based university. This chimera course would depend on the aide available from a teaching and learning center.

In 1975 the Danforth Foundation gave grants to 5 universities, including Stanford, to fund such centers, but by 1978 the Danforth Foundation had abandoned the project and only two of those 5 original institutions decided to continue their centers through the pains of internal funding - Stanford and Harvard (Stanford, 2004). Originally, Stanford's Teaching and Learning Center was only open to teaching assistants, but members of the faculty requested that it be opened to them. Harvard, arguably the most mature learning center in America, spans a wider spectrum to catch the needs of a wide audience and we will review some of the virtues of its center, but both the original remaining centers have done outstanding work in this developing field. A comparison of the two surviving learning centers would make an interesting study and there is certainly much to be learned from these models.

While Harvard and Stanford got off to an early start, later teaching and learning centers became site license subscribers of the National Teaching & Learning Forum, a great repository of learning on the subject of learning. For those universities and colleges which do not produce their own publications and videos for sale, as Harvard does, the site licenses for the National Teaching and Learning Forum can be a useful place to begin enriching teaching and bring a university faculty expertise and greater and more pedagogical tools (http://www.nltf.com/restricted). Mentoring handbooks, teaching excellence fellows, roundtable discussions, consultations with the director of the center, Fellows Colloquia, collaboratively planning and delivering presentations on subject-matter derived from the Colloquia are just a few of the practices found in the best centers and a review of these tools as best practice material can yield great results for a university or college starting up a program. Feedback on teaching, orientation of faculty and staff to university policies and procedures manuals, and teaching and learning resources are also addressed in the best centers. Likewise, Training Calendars or Learner Webs can be a great component of the best centers as are Faculty Orientations and transfer student welcomes. Learning Communities access, counseling, and appropriate placement of at-risk students are other subject-matter of interest. Even Writing Successful Grant tips and deadlines and guidelines for Instructional Enhancement Grants (Virginia Tech, 2005) may be included.

In these days when professor evaluations occur at RateYourProf.com and other websites, a major goal of teaching and learning centers is the improvement of learning through the improvement of teaching. While the goals of these centers are multiple, the agendas of the administrations that support them are often complex. The major desire of people associated with these centers is to improve learning partially through improved teacher training, microteaching sessions, a greater teacher understanding of the student and particularly through improved compassing devices to help the student solve problems before those problems negatively affect that student's ability to succeed in a college course or college at large. Using compassing mechanisms such as calendars to announce such events as computer workshops, offering special programs for instructor training in computer enrichment programs for their classes and professorial web pages, the Teaching and Learning Center becomes an excellent matrix for the creation of hybridizations of course offerings.

The value added through enriched resources available to the student as the students collaborate on line, increased socialization and group activities, create new learning cultures particularly for commuter campuses, enhance the disciplines, provide access to study group learning in ways that would have been impossible a decade ago, and provide opportunities to carve out professional linkages by gaining access to primary sources. The instructor, of course, gains in the area of course management as he or she attempts to get the time to create the optimum mix of the hybrid. Isn't that what hybridization is -- the optimum mix of independent learning, on-line discussion and cyber dialogue, F2F interchange and lecture? A cyber dialogue day on a subject can be particularly useful. As the participants discovered at the 2002 Ocotillo Retreat, using certain technologies for certain analytic and problem solving tasks can be predictable, although the creation of a Competency Matrix may take a certain trial and error working out for the instructor of a hybrid course using his or her own website in combination with the Teaching and Learning Center. At the 2005 Ocotella Retreat Craig Jacobsen first used the term “chimera course” to describe the adjustable hybrid course that we had been talking about in print without having created such a useful term.

Perhaps one can attempt to evaluate this for the entire hybrid class too rigorously as some students will use the on-line enrichment material more than others and learning how to match student learning techniques with flexible models may have its advantages as a beginning program. Research has not put to rest the question of whether there is an optimum model mix of "bricks and clicks" even within disciplines. Various subjects within the website and learning center sources will appeal to various students so those areas that are mandatory should be separated from those which are enrichment defined. This becomes simply a part of good course management, but it is a terrifically time consuming area of work for the instructor and relates to strategic planning of hyper-organized, cyber-enriched courses. This is where programs to support hybrids must come in. Course maintenance systems cannot just be the responsibility of the most cyber comfortable instructor. Teaching and Learning Centers must be available to assist in developing some of the enrichment goals of the courses.

The problem with optimizing the contingency hybridization potential of the learning center is that some centers have been used in relation to attempts to retrain professors who have fallen behind in gaining twenty-first century skills or departments that have fallen behind in strategic planning. Should a university reveal those who have not complied with the planning and course management policies? Perhaps the most punitive illustration of this sort of publication comes from the University of Montana, where the departments are listed according to the dates that they have submitted their Self-Study Report, Assessment Plan and Assessment Summary or, if nothing is submitted, the words "not submitted" are placed under the name of the department. Should our reader not believe that this was found in the Teaching and Learning Center web space, one has only to read the following: "Welcome to the Assessment web site. It is our goal to provide informative and useful information whether you are assessing your effectiveness as a teacher, student learning outcomes, or the effectiveness of your department's curriculum." (University of Montana Website, Montana, 2004).

Harvard's Derek Bok Center for Teaching and Learning

Harvard's famous teaching and learning center -- the Derek Bok Center for Teaching and Learning -- provides four portals -- one for faculty, another for Teaching Fellows, another for Students and a final portal for Visitors (where one can purchase Harvard Press materials on pedagogy). The center is part of the Faculty of Arts and Sciences. Its formal programs include the following: " …fall and winter term conferencing on teaching(September and January), microteaching, a form of supervised practice teaching; videotaping of classes, followed by private conferences; teaching in English for international teaching fellows and faculty; topic-based seminars on discussion leading, writing advanced case studies; seminars for junior faculty and senior teaching fellows; publication of videotapes, handbooks and documents; and other services to improve undergraduate education."(Harvard, 2004)

Perhaps most interesting for our discussion here, is the microteaching practice at Harvard, which is organized practice teaching which allows a group of teachers to work with an experienced teaching consultant before the beginning of fall semester to videotape what they intend to do during the opening of class and review that work. The practice is called "scenario-ing". The practice and then the evaluation of the practice allows for a teacher of access what he or she is planning on doing and make adjustments before it is too late. It also emphasizes the importance of teaching to Harvard, the Harvard community and, of course, the professor who will be teaching there. The practice is intriguingly like virtual flight training in the Air Force and allows for an instructor to make mistakes without harm to the students since that instructor is able to see and correct the mistakes before the first real day of class.

Other Best Practices in Teaching and Learning Centers

Many Learning Centers address compensatory programs designed to aide traditionally definable at-risk student population categories by aggressively providing academic support for students with one of the following status groups: students in economic distress, students of a minority race or ethnic group, transfer students, first semester Freshmen in general, first generation college students, and students who have tested into a class which suggests partial educationally disadvantaged status and potential at-risk status. Sections of Harvard's center that treat the freshman year experience or transfer students through their famous "transfer shock" orientation and special places as late comers to the university as well as commuter students and older or returning students can have their on-line space in the learning center as well as perhaps being invited into the geographical and literal space of those centers. If the physical space allowed the Teaching and Learning Center is attractive and inviting, a picture of the building or offices often accompanies the website home. First, the university's webpage invites those different cohort groups into the on-line center and then the on-line center invites them into the place where their correlative exists perhaps even in a year-by-year format.

Links to educational resources such as The American Council on Education and the Association of American Universities can flush out an Educational Resource Page as can on-line access to *The Chronicle of Higher Education* or the *Journal on Excellence in College Teaching*. Tufts University's teaching center has provided a tremendous resource by giving a worldwide listing of all university teaching centers (Tufts, 2002). Would we expect less from the university that gave us the Perseus Digital Library (Lane, 2004)? The Searle Center for Teaching Excellence at Northwestern University organizes website links according to Critical Thinking, Epistemology, and Technology and Teaching (Northwestern, 2004). Despite the fact that these Learning Centers are at major research private universities, Learning Support Centers can promote multicultural pluralism in many ways including additional resources and skills. The Searle Center for Teaching Excellence at Northwestern makes clear a problem by its highly intellectualized divisions of "critical thinking" and "epistemology." Are these Teaching and Learning Centers not increasing the success rate of the already largely successful at elite universities and thus widening the already wide learning gap between students at wealthy, elite schools and schools unable to support the expense of such centers? The presupposition of knowledge which those Northwestern subheads assume forces us into a series of other questions. If learning centers do not expand into urban public institutions, does not a kind of reverse "catch-up" scenario apply? Did Harvard really need their three decade head start? If Learning Centers do not proliferate into urban public institutions and even open door institutions will there not be a growing disparity between not only the quality of education offered at those institutions that can lead their students out of the quick sands of academia and those that cannot except on an accidental and individual basis, but also the success rate of those students in terms of graduation. If Teaching and Learning Centers are enrichment opportunities largely for the already advantaged, then the training which the privileged receive will continue to be increasingly better than the training that bright students at state and municipal colleges and universities have access to and thus become another excuse for giving some students the second chance of mercy and the learning center tools while other university students are marked for the harsh treatment of what may be a Darwinian jungle of lack of remedy, the rule of law, and a kind of severe justice.

Penn State’s partial solution to some of these issues deals with a student's ability to search out his or her professors and become the exceptions to the anonymous classroom situation. Penn State, with its large undergraduate classes, seems to open up areas that Harvard has not addressed as well. Penn State's outstanding Center for Excellence in Learning & Teaching includes Online Proposal Forms for its grant fund for teaching innovation and, unlike Northwestern and many other centers, separates undergraduate education from graduate. Penn State actually offers a Course in College Teaching available on its website and has two sections meeting once a week. In the spring semester, Penn State offers working luncheons for teachers of large class sections to help those who take gigantic classes with their special problems of anonymity and voicelessness. February through March there is also a "Take Your Professor to Lunch" program aimed at giving students in large class sections a chance to get acquainted with their professor. Obviously, Penn State’s Center for Excellence in Learning & Teaching is brilliantly constructed from the very moment that the title of their center placed learning before teaching. However, in some ways Penn State's on-line Center for Excellence in Learning and Teaching has implemented some best practices that could be duplicated at less prestigious universities, even transferred to open door institutions at little cost.

Arizona State University uses its Center for Learning and Teaching Excellence for its Rookie Camp as well as providing an outstanding semester by semester calendar of Workshops, Seminars and Conferences." (ASU, 2004), and runs its program out of the Office of the Senior Vice President and Provost. Not all teaching and learning Centers are the purview of the provost and the debate as to whom the learning center director should report to is still just that -- in debate. Arizona State uses its center to plan programs which will allow the first semester freshman to have friends and acquaintances and familiarity with the campus before they ever get to that campus as a freshman by replicating a program known to many teenagers before they get to college -- summer camp.

The invitation to the mainly literal geography of the Teaching and Learning Center does not mean that most students will not mostly depend upon the on-line segments of the Teaching and Learning Center. Literally, the on-line segments function as storage for forms, compassing mechanisms for workshops, symposia, and other events, calendars, and places to download links and materials. In short, the Learning Center is an enrichment program for Academic Support which encompasses programs and services for faculty and students. It backs up orientation for students and it may be useful for developmental courses like developmental math, English, reading, and study skills. Thus it plays a role in supplemental instruction. It may also have testing capabilities, tutoring notification and announcement of services for students with special needs including where to find the Disabled Students Office, the supplemental instruction locations, and other helpful sites such as tutoring projects, service projects, basic skills instruction, academic and personal counseling, and particularly in urban environments, enrichment projects such as field trips to museums, plays, art galleries and musical performances.

The Chimera Classroom Model

With all these responsibilities is it also possible that the center can be made ready to be used as a re-connect point in emergencies, contingencies, and at the beginning of regular and special sessions? The jury is still out on what a Learning Center can do in an emergency, whether the Learning Center is the proper place for a student to go who cannot get to class, or a professor to attempt to pick up information as to how to carry on classes that were face to face but now have to be modified into an emergency or contingency hybridization. So far, Teaching and Learning Centers have generally avoided contingency planning in relation to remedying class stoppages in times of emergency. However, its enhancing role is increasing the capability of class videotaping and other steps that will lead one to be able to continue class in emergencies such as those experienced in Hong Kong with the SARS epidemic, where the University of Hong Kong was able to save its semester through long-range contingency planning that included on-line hybridization. However, the chimera class model was demonstrated at the May 2005 Ocotella Retreat. The chimera class model would have online, hybrid face-to-face students in a single classroom encouraging students to use the model they need(Craig Jacobsen, Mesa Community College; Jacobsen@mailmcmaricopa.edu; Octotella Presentation#40).

Contingencies and the Teaching and Learning Center

There is little doubt that a Learning Center would be an excellent place to train people to get messages as to when and if the physical school is closed, what preparations have been made to move sites or to switch to hybrid capabilities. One doubts that the original plans of the Danforth Foundation in 1975 included such contingency planning, but Stanford, an original member of the five school Danforth group, states in the final words of its Purpose and Goals that the students "should see learning as extending far beyond the classroom to most of what they experience" (Stanford, 2004b). Philosophically anyway, they seem prepared to break down literal classroom walls and consider enrichment and contingency potential of hybridization. Assets like electronic portfolios can be steps which move towards hybridization which would have contingency possibilities. Instructional enhancement programs and instructional enhancement grants could be used to restructure existing courses so that they would be capable of effective implementation of contingency hybridization. These options would not include all contingencies. The kind of power outages that were experienced in New York, the Northeastern part of American and Canada were short-lived and even if they had not been, were not addressable by this plan. We are in the process of redefining teaching and learning spaces. The contingency hybrid course will be one of the new uses of space and it will require tools which create this on-line teaching space.

However, for now, the purpose of the teaching and learning center (TLC) in its contingency hybridization role is to serve as the one point of contact to re-connect all of the participants in the learning process. The participants in the learning process are classified according to their levels of communication and interaction. These levels of interaction include interactions as in virtual conversations between the teacher and student, between students as peers, between students and the learning content and finally between the students and the course delivery technology

Likewise, the Teaching and Learning Center's web site is the gateway, one point of contact and interface for connecting students to online discussion and collaborative sites as well as linking students to learning portals that are repositories of subject/discipline specific learning links, reading materials, simulations, games and learning objects such as Avatars. Professors in the contingency hybridization model use the learning portals and the repository of learning materials as a means to enhance and extend the learning process inside class, outside of class and during periods when events require that the campus shutdown. Given this repository of learning materials, professors have the option of calling upon various learning resources as classroom supplements and demonstrations in much the same way as they might select entrees from a cafeteria.

Saying that the Teaching and Learning Center is the linchpin that connects the parts of the learning process together sums up the Teaching and Learning Center's contingency hybridization role. Without the linchpin, the learning process cannot work during time periods when the campus must be shut down due to natural disasters or due to operational failures such as power outages or other equipment failures. In normal times, the Teaching and Learning Center linchpin can work to enrich the learning process by fostering a more cohesive, collaborative learning dynamic. The professor determines how to use this resource based on the learning requirements for the course or program. Goals and outcomes will forge new partners in teaching and learning and create new tools for both the teacher and the student as the center functions in the capacity of learning assistance. Courses using the chimera model will forge new options, decrease the number of failed courses and encourage greater flexibility thus the Center will augment the departments in learning support. K. V. Lauridien examined the scope of learning centers in 1980 and did not consider contingency hybridization, but as individual centers have grown and the concept has proliferated, new roles are likely to be added and a variable level of computerization of the course can help deal with events which might otherwise destabilize the learning process and its hierarchies. All this makes a grand assumption, however, and that is that high quality Teaching and Learning Centers will continue their proliferation pattern from private universities such as Harvard, Stanford and Northwestern to public universities and large community colleges.

Conclusions and Recommendations

These hybrids can solve many problems. A hybridization of a course might stabilize a course during the illness or absence of a professor or student, the death of a professor, or simply enrich the course with added materials by providing exercises for students who are in need of additional practice sessions to achieve competency in a particular task or in a content area. Thus the teaching and learning center may have an online lab and tutorial capabilities. These centers can be designed to solve many student problems from student transfer shock to student disorientation to celebrating teaching excellence or to solve one major problem over and over again. Perhaps the teaching and learning center is the most effective response that a university or college can make to the challenges of several kinds of hybrid courses. Learning grants support faculty in the difficult task of creating enriched, hybrid courses through state of the art computer software, facilities and training and access to hybrid course resources (Maricopa, 2002).

One immediately notes that these are called "Teaching Centers" and the philosophic implications of leaving learning out of a teaching center implies that learning is not at the center of the teaching and learning center. The best teaching and learning centers seem to focus on the real desired outcome -- learning. When a center focuses on learning as the outcome, it prepares itself for goal-driven remedies to problems in learning. Contingency hybridization can piggyback on the very material already placed in a learning center for the enrichment of students -- online study guides, syllabi, course chat rooms, quizzes which collect data as well as test, lecture notes, discussion groups, interest sections, and research groups. Material with a timed delivery can be simultaneously presented and its return timed precisely. Special symposia or programs related to the curriculum can be announced in the calendar -- compass or crossroads -- a major section of any good learning center.

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Editor' Note: This paper presents some interesting data on the use of technology in by mathematics teachers. It raises issues for pre-service and in-service training of classroom teachers, for curriculum design, and also for the quality of teaching and learning resources available in schools. Is adoption of media to facilitate learning a human problem or a systemic problem in classroom teaching? And is this problem local or global in magnitude?

How Technology is Integrated into Math Education

Aytekin Isman and Huseyin Yaratan

Abstract

The main focus of this paper is to determine math teachers` perceptions on using educational technology in their classes. Research results indicate that most math teachers do not use educational technology to teach mathematics even though educational technology motivates students to learn more. In addition, t-test and ANOVA results revealed few differences on using educational technology in their classes in terms of math teachers` gender, experience and level of education.

Introduction

Technology is the practical application of science. Technological developments began two hundred years ago when teachers started to use abacus in their classes. After the development of a technology, it impacts the lifestyle of people. For example, computer based systems help people to successfully organize their companies. The Internet helps people to reach information fast.

Beside development in information technologies, new teaching and learning methods are being introduced to advance contemporary education. Technology supports global thinking in an educated society and provides information to adopt new teaching and learning developments. Technology also creates flexible learning environments in which students can easily construct and learn new information and store it in their long term memory. Technological developments enable teachers and students to acquire up-to-date knowledge and support critical thinking. Technology is a combination of hardware and software (Isman, 2002). It is important to determine appropriate technology to increase productivity based on student` and teacher` needs.

Potentially, technology increases productivity in educational activities and affects the quality of education in terms of meaningful learning and effective teaching. It offers the possibility to solve problems and enhance the stability and quality of learning in a coherent manner (Isman, 2003). Technology is not only electronic instruments; it includes new teaching-learning methods that can be used in a beneficial way in education (Isman, 2003).

Rapid technological developments have impacted education. It can be said that the practice of teaching mathematics has been more traditional than any other curriculum area, yet technological developments have affected mathematics education also. Technology can help math teachers to solve issues and problems in math education.

Issues and problems in math education

Problems in math education include:

1. low motivation to learn math,
2. transfer of problem solving skills to real life situations,
3. low value given to mathematics, and
4. no standards.

The first problem is about motivation. Teaching math with classical teaching methods discourages some students so that the students do not want to learn math. Classical Math teachers do not know how to motivate students in their classrooms and students need to be motivated by their teachers to learn.

The second problem is to solve math problems in real life situations. Most math teachers do not use real life examples to help students to use math in their lives. Math teachers should use real life problems and emphasize problem solving skills to help students to understand math.

The third problem is a low value given to mathematics. Math teachers must teach their students how to appreciate and understand the value of mathematics in everyday life. Then students will begin to respect math applications in society.

The last problem is about math standards. In today's technology-based society, math educators need a new math curriculum designed to integrate new developments, set new standards, and incorporate new technological developments such as computer based instruction.

Technological applications in math education

Teachers and students have access to valuable resources via the Internet that include software, simulations, spreadsheet, and graphing calculators (Roblyer & Edwards, 2000). Students can learn mathematics using comprehensive math tutorials. Drill and practice programs offer instant feedback for skill building. Higher learning skills can be acquired through geometric exploration programs where learners create shapes, experiment with mathematical formulas and visualize data in graphic formats.

Computer software offers quick and easy transformation of data to graphics to learn transformational geometry such as tessellations. It can interface with devices like probeware systems to capture data. Students can conduct experiments and concept demonstrations using these devices.

Spreadsheet programs, such as Excel, offer graphics, algebraic functions, equation editors, calculator, and word processor to support complex calculations and writing research papers. Spreadsheet program can be used by the student to allocate a budget and compare alternative options with ''what if'' activities. Variables can be changed easily so students can quickly learn the dynamic aspect of budgeting. Spreadsheets are also used to search for patterns, construct algebraic expressions, simulate probabilistic situations, justify conjectures, generalize concepts and graph chart data.

Search engines on the Internet provide access government and commercial data for statistical analysis, web tools to conduct surveys and polls, and simulations that replicate real life experiences. Computers also support collaborative learning, Web-Based Instruction (WBI), Inquiry (problem) based learning, and the opportunity to solve the 'problem of the week' on the Web.

Simulations can be used to mock stock market trading and immerse students in occupations such as doctor, engineer, detective and fire fighter to visualize how math is used in real life cases.

The Aim of Research

Educational technology is a key to the success in math education. The goal of this research paper is to find out teachers perceptions about using technology for math teaching by analyzing the relationship that exist between teachers' perception of educational technology in relation to gender, age, experience, and educational level.

Problem Statement

Using the current literature as a guide, this study attempted to answer the following questions:

1. Is there any relationship in the teachers' perceptions of educational technology based on gender?
2. Is there any relationship in the teachers' perceptions of educational technology based on age?
3. Is there any relationship in the teachers' perceptions of educational technology based on experience?
4. Is there any relationship in the teachers' perceptions of educational technology based on educational level?

Significance of the study

The results of this study can be used by educators to determine the benefits of the use of educational technology for math teaching.

Scope and limitations

In this study, a sample size of 50 teachers was used. This was the number of teachers that taught math courses in Gazi Magusa, North Cyprus, during the Fall semester, 2003. Only twenty math teachers filled out the survey. This study is subject to the following limitations:

1. The data was collected through the administration of a survey instrument.
2. The study assumed truthful, candid responses by respondents who understood and were not fearful of reprisal for their completion of the survey instrument.
3. The responses to the survey items by the respondents were subject to unknown personal biases and perceptions.
4. The study was non-experimental in that the investigators did not have manipulative control of the independent variables; therefore, no explicit cause and effect relationship could be determined.

Method

Operational Definition of Variables

This study was designed to examine teachers' perceptions of using educational technology for teaching mathematics and to compare their perceptions based on gender, age, experience, and educational level.

Independent variables:

Teacher's Characteristics.

a. gender,
b. age,
c. experience,
d. level of education.

Identification of the Population

The population under investigation included teachers teaching mathematics courses at middle and high schools in North Cyprus. Groups in this study represented math teachers in North Cyprus.

Sample

Sample selected by the method of random sampling as twenty teachers from the public schools of the Ministry of Education and Culture of North Cyprus for administering a questionnaire prepared to assess perceptions of teachers about the use of technology in their mathematics lessons.

Instrument

For this research study, a questionnaire was used. This questionnaire was designed for analyzing teachers' perceptions. There were forty items in this instrument. Their responses are on a series four-point Likert-scale (1=never, 2=sometimes, 3=often, 4=always).

Data Collection

The teachers' perceptions were assessed by the prepared questionnaire. Teacher responses to the questionnaire were statistically analyzed according to gender, age, experience, and educational level.

Data Analysis Procedures

A quantitative research method was used to investigate the research problem. The survey questionnaire was designed to measure the perceptions of teachers.

1. The copy of a survey was given to each mathematics teacher.
2. After filling out questionnaire, the teachers gave them back to the researchers.
3. Tthe frequency data indicated the level of satisfaction for each item.
4. ANOVA and t-test were used to analyze each item to compare potential relationships in ratings based on gender, age, experience, and educational level.
5. The data were analyzed using the SPSS for Windows. In this process, an alpha level of 0.05 was used to test each hypothesis.

Data Analysis and Presentation of Findings

The main purpose of the study was to investigate teachers' perceptions of using educational technology based on gender, age, experience, and educational level. Data for analysis were obtained from the questionnaire survey. Results of quantitative statistical analysis and interpretation of data collected from twenty math teachers are presented below.

Quantitative Data Analysis

Demographic Data

Table 1
Teacher Gender

Male	Female
55% (11)	45% (9)

Table 2
Teacher Age

25 and below	26-30	31-35	36-40	41 and over
5% (1)	30% (6)	30% (6)	30% (6)	5% (1)

Table 3
Level of Experience

0-5 year	6-10 year	11-15 year	16-20 year
5% (1),	40% (8)	45% (9)	10% (2)

Table 4
Educational Level

2 year program	bachelor degree	masters degree
5% (1)	80% (16)	15% (3)

Results of Hypothesis Testing

According to independent samples t-test results for gender, almost all of values are higher than the standard value that is table α 0.05. On the other hand, there are some differences on search engines (calculated α t value 0.023), Excel (calculated α t value 0.021), digital camera (calculated α t value 0.039), CD-ROM (calculated α value 0.011) and printer (calculated α t value 0.038) based on genders. Male math teachers use search engines, excel, digital camera, CD-ROM and printer more than female math teachers.

According to ANOVA results, there is no significant difference among teacher age groups. All of the values are higher than table α: 0.05.

According to ANOVA test results for experience, almost all of values are higher than the standard value that is table α 0.05. On the other hand, there is only one differences on using digital camera (calculated α value 0.043) based on teacher experience. Math teachers who had experience between 0-10 years of teaching use educational technology more than others.

According to ANOVA test results for education level, almost all of values are higher than the standard value that is table α 0.05. On the other hand, there are only two differences on using figure-table (calculated α value 0.018) and using television (calculated α 0.016) based on education level. Math teachers who had undergraduate and graduate education use educational technology more than others.

Table 5
Frequencies of Individual Items

Used in their classes	Never used	Sometimes used	Often used	Always used
blackboard	5% (1)			95% (19)
charts	20% (4)	30% (6)	30% (6)	20 % (4)
figures and tables	5% (1)	15% (3)	55% (11)	25 % (5)
book / books	5% (1)	5% (1)	35% (7)	55 % (11)
notice wall panel	40% (8)	25% (5)	25% (5)	10 % (2)
question book	5% (1)	20% (4)	20% (4)	55 % (11)
measurement instrument	20% (4)	55% (11)	5% (1)	20 % (4)
drawing instrument	20% (4)	60% (12)	10% (2)	10 % (2)
3D model	40% (8)	25% (5)	20% (4)	15 % (3)
internet	65% (13)	15% (3)	5% (1)	15 % (3)
web page	80% (16)	10% (2)	10% (2)	
camera	100% (20)			
chat systems	85% (17)	10% (2)	5% (1)	
teleconference system	95% (19)	and 5% (1)		
search engines	75% (15)	5% (1)	5% (1)	15 % (3)
calculator	45% (9)	40% (8)	5% (1)	10 % (2)
television	75% (15)	5% (1)	15% (3)	5 % (1)
video	85% (11)	15% (15)		
CD	75% (15)	20% (4)	5% (1)	
film	90% (18)	10% (2)		
video camera	100% (20)			
radio	95% (19)	5% (1)		
video tape	100% (20)			
overhead projector	75% (15)	25% (5)		
special course computer program	65% (13)	30% (6)	5% (1)	
practice programs	80% (16)	20% (4)		
dia	100% (20)			
Windows	55% (11)	10% (2)	20% (4)	15 % (3)
DOS	85% (17)	15% (3)		
Word	55% (11)	25% (5)	5% (1)	15 % (3)
PowerPoint	70% (14)	15% (3)	5% (1)	5 % (1)
Excel	65% (13)	15% (3)	10% (2)	10 % (2)
scanner	85% (17)	5% (1)	10% (2)	
digital camera	85% (17)	15% (3)		
CD-ROM	70% (14)	10% (2)	5% (1)	15 % (3)
data projector	85% (17)	5% (1)	10% (2)	
multi media	85% (17)	5% (1)	10% (2)	
printer	70% (14)	10% (2)	20% (4)	
laptop	80% (16)	, 5% (1)	15% (3)	

Results of Hypothesis Testing

According to independent samples t-test results for gender, almost all of values are higher than the standard value that is table α 0.05. On the other hand, there are some differences on search engines (calculated α t value 0.023), Excel (calculated α t value 0.021), digital camera (calculated α t value 0.039), CD-ROM (calculated α value 0.011) and printer (calculated α t value 0.038) based on genders. Male math teachers use search engines, excel, digital camera, CD-ROM and printer more than female math teachers.

According to ANOVA results, there is no significant difference among teacher age. All of the values are higher than table α: 0.05.

According to ANOVA test results that were done for experience, almost all of values are higher than the standard value that is table α 0.05. On the other hand, there is only one differences on using digital camera (calculated α value 0.043) based on teacher experience. Math teachers who had experience between 0-10 years of teaching use educational technology more than others.

According to ANOVA test results that were done for education level, almost all of values are higher than the standard value that is table α 0.05. On the other hand, there are only two differences on using figure-table (calculated α value 0.018) and using television (calculated α 0.016) based on education level. Math teachers who had undergraduate and graduate education use educational technology more than others.

Conclusions

According to frequencies, math teachers do not use much educational technology in their classes. In addition, t-test and ANOVA test results indicate that there were few differences on using educational technology in their classes in terms of gender, experience and education level.

On the other hand, educational technology could motivate students to learn more so math teachers should use more educational technology to enrich their teaching activities in their classes.

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Editor's Note: Instructional design, learning management, and a different philosophy make this online statistics course an acceptable alternative to its classroom counterpart. The author clearly outlines the steps taken and provides statistics to report the results.

Teaching an Introductory Graduate Statistics Course Online to Teachers Preparing to Become Principals: A Student-Centered Approach

Gibbs Y. Kanyongo

Abstract

This article discusses the teaching of an eight-week statistics course that is delivered entirely online and how it promotes student-centered learning. Students enrolled in this class are school teachers who are working towards certification to become principals. This course is one of the several courses they are required to take for them to fulfill the requirements of the program. The course is intended to equip students with the skills that enable them to read and understand the statistical information in research literature relevant to school problems and issues.

The paper begins with a brief introduction of some of the benefits of online learning, with an acknowledgement of some challenges that online learning poses. Next, the paper presents the framework for student-centered learning and contrasts that to teacher-centered learning; then the link between student-centered learning and Web-based learning is illustrated. Finally, the paper shows how the two concepts were integrated into teaching a statistics course online. This paper is not advocating student-centered learning as being superior to teacher-centered learning, but recognizes the two approaches as being on two ends of a teaching philosophy continuum.

Key Words: correlation; regression; web-based learning; student-centered learning; teacher-centered learning; collaboration; statistics.

Introduction

Smith (2001) listed many of the benefits that online distance education provides for students and faculty members. Some of the benefits for students include accessibility, flexibility, participation, absence of labeling, written communication experience, and experience with technology. On top of these benefits, faculty members also enjoy employment advantages derived from newly gained skills. However, there are challenges as well, notably issues concerning team building, security of online examinations, absence of oral presentation opportunities, and technical problems. From the faculty perspective, there is a lot of time involved, and activities include designing courses, learning new technologies, and resolving technological problems. The benefits of online learning contribute to the strong support for and rapid development of distance education in many settings, while the challenges cause the indifference or hesitation in others.

Teaching statistics concepts in an online environment presents major challenges to both the instructor and the students. It is a challenge to the instructor because the instructor should be able to communicate the statistical concepts in a manner that students understand. It is a challenge to students because of their varying levels of preparedness, complexity of content and technological expertise. Despite all these challenges, the experiences of this author are that teaching statistics online can be effective if the course is properly designed.

Student-Centered Approach

In student-centered environments, the content change involves a dual function: (a) establishing a knowledge base and (b) promoting learning. Weimer (2002) points out that in learner-centered approach, content becomes the means whereby learning outcomes are advanced. She points out that there are three ways in which instructors can use content to teach students about learning. First, instructors should "use" content not "cover" content as a vehicle to develop learning skills. This means that instructors help students acquire a repertoire of strategies, approaches, and techniques that they can use when they need to learn material in a particular discipline. These may be basic skills, like time management, collaboration, communication and computational skills, important to learning almost any sort of material.

Second, content should be used to promote self-awareness of learning. Students need to be made aware of themselves as learners and develop confidence in their ability to work on learning tasks. They should be able to have a self- assessment of their strengths and weaknesses as learners, and then develop strategies that help build on their strengths and make up for the weaknesses. Weimer (2002) sees self-awareness as the foundation on which further development as a confident, self-directed, and self-regulated learner grows.

Third, content promotes learning when students are given the opportunity to use content so that they learn and experience it firsthand. In learner-centered environments, active learning strategies should be used all the time. Students should have hands-on learning experiences, not just listen to the instructor explain some concepts. For example, rather than having the instructor tell them about the outcome of an experiment, students are given the data and challenged to perform analyses, and come up with meaningful results. These three features promote active learning by students that allow them to have firsthand experience with the content.

Most people mistakenly believe that learning skills develop by osmosis; for example, if an instructor solves problems on the board, students learn problem-solving skills. Research does not support that notion. Woods (1987) found that in a four-year engineering program, students observed instructors working more than one thousand problems. The students themselves solved more than three thousand homework problems, and yet despite all this activity, they showed negligible improvements in problem solving skills. He pointed that what they acquired was a set of memorized procedures for about 3,000 problem situations that they could, with varying degrees of success, recall.

Student-centered and instructor-centered practices are viewed as representing opposite ends of the teaching philosophy spectrum. Student-centered practices are considered to have an underlying constructivist philosophy while the teacher-centered approach is grounded in the positivist philosophy (Knowlton, 2000). Three constructivist notions are the basis of student-centered approach. The first notion is that, knowledge acquisition is an active process where the student makes sense of the world rather than merely accumulating facts. The second one being, students internalize new knowledge in personal ways, by creating relationships to existing knowledge thus enabling application; and third, knowledge has a cultural aspect that relies on collaboration and social negotiation to give shared meanings (Grabinger, 1996).

Students in the teacher-centered environment receive knowledge from the instructor, internalize the knowledge, and later, reflect the knowledge back during assessment. The meaning, personalization of the knowledge, and linking of new knowledge to the student's existing knowledge structures are left entirely to the student and take place outside of the teaching process. The teacher-student relationship is one of disseminator and recipient which assume that the teacher has 'monopoly' over knowledge. This does not imply that the "facts" are different for learner-centered approaches; only that intentional effort is applied to providing students an opportunity to individualize the context and meaningfulness of the knowledge within the context of the teacher-learner interaction.

The Internet and Web-based Learning

With the internet's rapid growth, the web has become a powerful and interactive medium of learning and teaching. The web provides the opportunity to develop learner-centered instruction and teaching. Recent studies have shown that the internet can be an efficient instructional technology in higher education. For example, studies by Corrent-Agostino, Hedberg, and Lefoe, (1998) showed that the internet facilitated graduate students understanding of problem-based learning principles. A study by Lockyer, Patterson, and Harper, (1999) showed an improvement in undergraduate students' understanding in a health-education course. Liou, (1997) showed that the reading of comprehension and writing skills of English as a Second Language of college students improved when supportive web-based materials were used.

Web-based instruction is a *hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported*. (Khan, 1997). Gillani and Relan (1997) define Web-based instruction as t*he application of a repertoire of cognitively oriented instructional strategies implemented within a constructivist and collaborative learning environment, utilizing the attributes and resources of the World Wide Web.* They suggest the Web may be used as a:

1. resource for identification, evaluation and integration of information
2. medium for collaboration and communication of ideas
3. platform for expression of understandings and meanings
4. medium for participating in simulated experiences, apprenticeships and cognitive partnerships.

They point that these uses exploit the release of learning from the constraints imposed by traditional modes of delivery while changing the roles of teacher and learner and the way in which knowledge is structured.

Web-based teaching tools help reduce teachers' administrative duties, allowing them to focus more on teaching and meeting students' needs. Teachers can assign notes, documents, projects, homework and other student evaluations as far ahead as they like, with the students taking more responsibility for keeping track of their own work schedules.

Web-based learning provides students tools that give them more ownership of their grades and work with demonstrable results. Web tools help in improving the students' ability to learn. Students can write their teachers after school hours asking questions regarding their assignments, and teachers are there for the students during any part of the day. In addition, the Web tools have also been an aid to students who are less inclined to play a vocal role in class. Some students are just not "classroom" people; hence web tools help teachers make the connection between teacher and student.

Bostock (1997) contrasts the use of the Web for transmission of information to passive learners in a traditional framework with an active, collaborative learning approach. He offers a summary of the nature of active learning from a constructivist viewpoint. He provides a list of features identified by Grabinger and Dunlop (1996):

1. Student responsibility and initiative to promote ownership of learning and transferable skills
2. Intentional learning strategies, explicit methods of learning, reflection on learning processes, meta-cognitive skills

3. Goal-driven, problem-solving tasks and projects generating products of value
4. Teachers as facilitators, coaches and guides, not sources of knowledge, requiring discussion between teachers and learners
5. Authentic contexts for learning, anchored in real-world problems
6. Authentic assessment strategies to evaluate real-world skills
7. Cooperative learning

Collaboration

Collaboration is an important part in most of the more innovative courses delivered via the Web. Groups of learners interact and develop the attributes of a 'virtual learning community', even though they may never meet in the same place or time. Shrage (1991) defines collaboration as the process of shared creation of two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own.

Description of the Course

The course title is “Statistics in behavioral research”, and the main goal of this course is to provide students with tools to be able to read, interpret and communicate clearly statistical concepts in their fields. In this particular section of the course, a total of 15 students were enrolled and the course was delivered entirely online. All the students enrolled in this course were in the process of being certified to become principals. Thus, the course was particularly focused on the needs of school principals to: (a) understand the data they use to make decisions in schools and districts; and (b) read and understand the statistical information in research literature relevant to school problems and issues. Specifically, the student will be able to:

1. accurately define and understand basic vocabulary commonly used in quantitative inquiry
2. read and interpret basic descriptive statistics.
3. read and interpret basic inferential statistics.
4. apply research results to problems of professional practice.

The course is offered through special web-based software (First-Class). Students enrolled in this class receive the software which they install on their computers at home or work. The software is user-friendly that no special training is required before they use it. All course information such as syllabus, with detailed course objectives, course requirements, assignments, and projects are available on the course site. The course site provides links to various resources useful to the course. For example, there are links to some online statistics books for students to use as references. Other sites the course is linked to include: Center for Research on Evaluation, Standards and Student Testing site, American Institutes for Research site, and a RAND Corporation site that publishes reports on educational issues.

A timeline with due dates for assignments and projects is also on the course site so the students know exactly when a particular project or assignment is due. Students only have access to a particular week’s activities, and can not work ahead since those materials are not available. Activities for a following week are made available on a Friday afternoon so that students have the weekend to review the material.

In the course, students are required to: (a) work on individual assignments, based on a statistics workbook, (b) work on group projects, (c) participate in weekly chat sessions with instructor, d) participate in group discussions with fellow group members on projects, and e) participate in the general bulletin board for the course where the instructor posts questions for discussion. A pictorial layout of the course environment is shown in Figure 1 below. The design of the course and the learning environment are such that they are user-friendly, providing the students the opportunity to explore with ease and contribute meaningfully to the activities of the course.

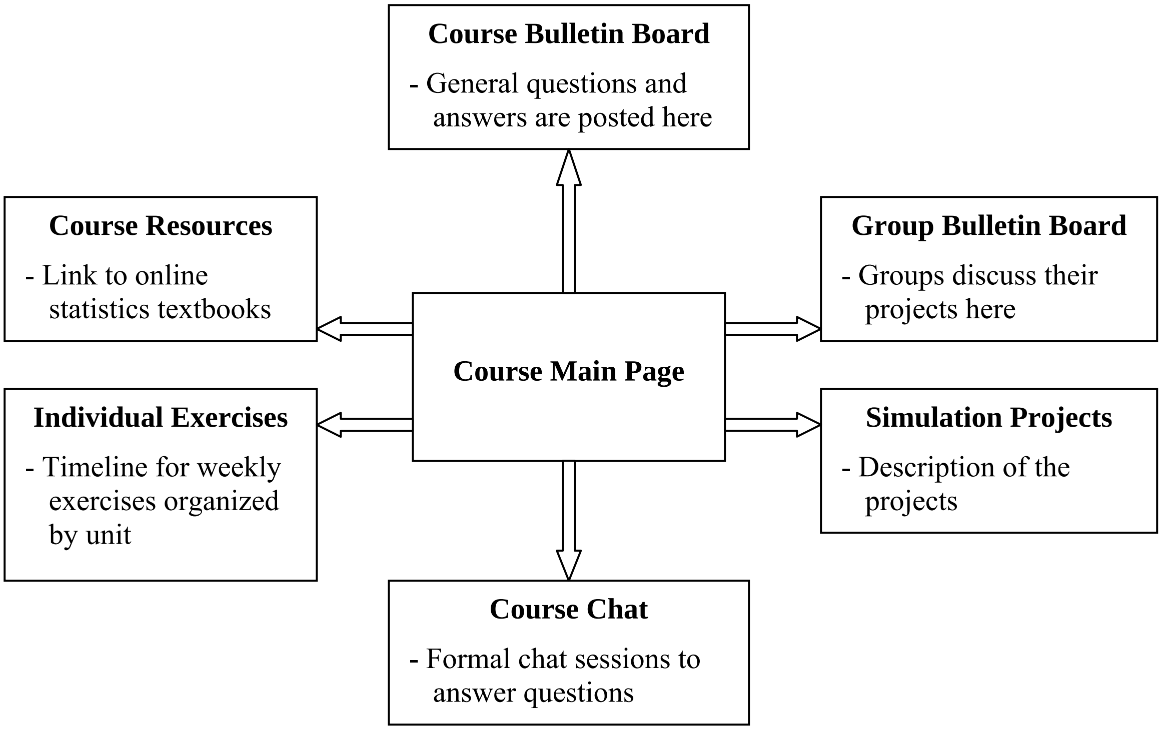

Figure 1. A pictorial layout of the course environment.

Learner-Centered Practices Online

The most critical task is to understand the essential characteristics necessary for each of the learner-centered practices. The important questions in this regard are: What elements are necessary for collaborative learning? What are the necessary elements for problem-based learning? What must be done to employ self-directed learning? Each of these strategies includes a process or sequence of activities and specific practices that make the method successful. We must incorporate the required elements of the practice in the online version. The challenge is not just replication, but enhancement using the technology's unique advantages. The following class activities illustrate how the students are at the center of the learning universe with the instructor playing the role of a facilitator.

Class Projects

Students are divided into three groups of five students in each group, and each group is assigned a simulation project. There are a total of three simulation projects for the course that the students work on in groups. After each project, the groups are dissolved and new ones formed for the next project. By the end of the course, each student would have had the opportunity to work with several members in the class. Each group has a discussion site where they 'meet' to discuss the group projects. Because the transcript is automatically archived, the instructor has the ability to check the site for the discussion transcript to see each student's contribution to the discussions. Each of the three projects provides the students the opportunity to apply the statistics concepts learned in this course to their situations as school administrators. As an example, in the first project, students are provided with aggregated and disaggregated data for 5th grade Math and Reading scores for a virtual school district. In the project, students are required to:

- Decide what story the data are telling (interpret the data)
- Decide what kind of statement(s) they will make
    - to district administration and
    - to the public based on the data
- Decide what, if any, actions they will take in their school (or advocate for taking, if district level involvement is necessary)

In this project, students should show the ability to interpret basic statistics concepts like mean, percentages, and histograms and how these apply to test scores.

In the second project, students are required to apply knowledge of such topics like sampling, test scores, correlation, and regression. They are given research articles on educational issues; for example, "The relationship between grade inflation and proficiency." Such an article incorporates concepts like sampling and sample size, correlation, correlation coefficient, and regression. Students should be able to show their knowledge of these concepts by interpreting correctly the research articles and critiquing them.

In the third project, students are required to conduct their own research on a topic of their interest. Each group agrees on a research topic, and they then conduct literature search of their topic. The third research project specifically teaches students to conduct online research of various research databases. They should also be able to interpret the statistical analyses used in the different articles they researched. They should be able to evaluate the information they get to determine what is relevant and what is not relevant to their particular topic of interest, and be able to synthesize their findings into a concise document. This is important because, according to (Weiner, 2002) "today's learners must be able to access information, find resources, organize them, and, perhaps most important, evaluate the ocean of information that now exists in that electronic sea" (p.50).

In each of the projects, students assign each other particular sections that individuals work on for the project. Before the final document is submitted to the instructor, members of the group circulate their sections to all the members of the groups for suggestions and changes. Each of the projects show an increased level of complexity compared to the one before it. Project one asks students to interpret data that were "handed" to them; Project two asks them to interpret data in articles that were handed to them; and project three asks them to find data in articles relevant to something they want or they need to know about. They then use statistical concepts they have learned in the course and the application skills they have been practicing.

Individual Exercises

For individual exercises, students complete exercises in a statistics work book, and submit to the instructor electronically for grading. The instructor provides written feedback to each student with detailed explanation on the wrong answers. The exercises are discussed during chat sessions with the instructor, and if there are any misconceptions arising from the exercises, they are clarified. Students do not have to wait for chat sessions to ask questions, since they can email the instructor any time. The instructor provides detailed feedback to any question/concern from a student within a reasonable time frame, usually, the same day.

Participation in weekly chat sessions with the instructor is done in one-hour long sessions. The students are put in groups (not the same as project groups). Each group meets with the instructor in a chat session on a particular day of the week. Chat sessions for any particular week seek to achieve clearly laid out objectives, usually tailored towards that week's individual exercises. Participation in online chats is strictly enforced, and students require prior permission from the instructor if they are to miss a chat. If they do miss, they are encouraged to join the chat for the other group for that week.

When students are online working on individual exercises, they have the ability to check and see who is online at that particular time. If other students are online as well, they can invite someone for a chat and can ask questions to the instructor in real time situations, if the instructor is online at that same time.

Course Content

The major topics covered in this course are:

- Percentages
- Mean percentages
- Frequency distribution
- Mean, median, mode
- Variance, standard deviation, range,
- Interquartile range
- Cumulative percentages and percentile rank
- Histograms
- The normal distribution curve
- Standardized scores
- Effect size
- Correlation and regression
- Multiple correlation
- Linear regression
- T-test

Evaluating Students Learning

Use of multiple assessment techniques is necessary to derive reliable results when evaluating students learning outcomes. In this course, students' learning outcomes were assessed by a variety of means that include individual assignments, group projects, participation in weekly chat sessions, participation in bulletin board discussions and participation in group discussion sessions. In each of the activities, students are graded based on a rubric which is specific to that particular activity. The rubric for each activity is available to students at the beginning of each activity so that they know exactly what areas they will be assessed on. Table 1 shows a rubric that was used to grade the first simulation project. The assessment techniques are quite comprehensive and thorough, and because of the fact that comments are written, which usually requires more effort from both the students and instructor, it means there is a lot of detail involved.

One of the advantages of this is that all communication between instructor and students is automatically archived. Faculty members and students can access transcripts of past chats to determine levels of participation and accuracy or to review guidance and explanations. Providing students with immediate feedback is another practice that helps students derives maximum benefit from the online learning experience. Actually, in this course students consistently pointed out that the one thing they appreciated most was the immediate feedback they received on their assignments and projects.

Table 1
An example of a grading rubric used for the simulation project

	A	B	Do-Over
Participation	Active, substantive (contributes to the work, not just its format)	Active, at least partly substantive	Inactive
Interpretation of the Data: Observations	Multiple (3 or more) correct conclusions, no major misinterpretations	One or two correct conclusions, any misinterpretations are minor	Major misinterpretations of the data
Interpretation of the Data: Statistical Reasoning	Clear, correct, and complete descriptions of percentage and measures of central tendency and variability, clear and complete descriptions of the logic used to interpret them, including the logic behind any comparisons	Partially complete or partially correct descriptions of percentage and measures of central tendency and variability, partially complete descriptions of the logic used to interpret them	Incorrect descriptions of percentage and measures of central tendency and variability, and/or lack of clear logic used to interpret them

Student Evaluation of the Course and the Instructor

Student learning was evaluated using the Teaching Effective Questionnaire (TEQ). The TEQ instrument consists of 10 items that ask students to rate the instructor and the course on a Likert scale ranging from 1 to 5 with 1 being strongly disagree and 5 strongly agree. The items and the mean scores on each item are shown in the Table 2 below. The mean scores are reasonably high (the lowest being 4.07 out of 5.00), and comparable to those obtained by the author for a similar course taught in a face-to-face classroom. Table 3 shows the mean scores for a similar class taught by the same author in a face-to-face environment.

Table 2
The mean scores for the items for the online class

Item	Mean
The instructor explained the course objectives clearly	4.29
The instructor was well prepared for class sessions	4.21
The instructor made effective use of class time	4.23
The instructor explained concepts and ideas clearly	4.07
The instructor answered questions in a helpful way	4.50
The instructor was willing to meet with students outside of class time	4.71
The instructor assigned grades fairly	4.57
The instructor made the course content interesting	4.29
The instructor significantly increased my understanding of the subject matter	4.50
Overall, the instructor is an excellent teacher	4.36

Table 3
The mean scores for the items for the face-to-face class

Item	Mean
The instructor explained the course objectives clearly	4.50
The instructor was well prepared for class sessions	4.70
The instructor made effective use of class time	4.08
The instructor explained concepts and ideas clearly	4.08
The instructor answered questions in a helpful way	4.50
The instructor was willing to meet with students outside of class time	4.36
The instructor assigned grades fairly	4.88
The instructor made the course content interesting	4.35
The instructor significantly increased my understanding of the subject matter	4.36
Overall, the instructor is an excellent teacher	4.45

Conclusion

Teaching statistics online can be as effective as classroom teaching especially when instructors use content to help students acquire learning skills, use content to promote self-awareness of learning by students, and let students use content so that they experience it firsthand. The most important issue is not whether statistics should be taught online or in a classroom. The important issue is whether the course promotes a learner-centered approach. A course is likely to achieve its objectives if students become the center of the instructional universe, and when the content functions as a means as well as an end of instruction.

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